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ABSTRACT A Commission on Instructional Technology has been established to assist the nation to meet some of the most pressing educational needs. The Commission's task was to determine if belief in technology's value for education is justified. The starting point of the study is learning. The value of any technology used in education is therefore measured by its capacity to improve learning. In the conviction that technology can make education more productive, individual and powerful, give instruction a more scientific base, make access to education more equal, more democratic, the Commission concludes that the nation should increase its investment in instructional technology. Six recommendations are proposed: (1) Establish the National Institute of Education--well funded and broadly based; (2) Establish a National Institute of Instructional Technology within the National Institute of Education; (3) Establish a national center or library of educational resources; (4) Propose projects to demonstrate the value of technology for instruction; (5) Support programs based on stepped up research and development to train and retrain administrators, teachers and specialists; (6) Establish a National Council of Education and Industry. The Commission envisions that education can be improved by the possibilities inherent in the new technology. The Commission believes that following its proposals will help achieve this vision. (ON)

—AA 000 470

TO IMPROVE LEARNING

Commission on Instructional
Technology

Washington, D.C.
August 1969

ED 034 905

A-X

TO IMPROVE LEARNING

A report to

the President and the Congress of
the United States

by the

Commission on Instructional Technology

Washington, D. C.
August 1969

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Dear Mr. Finch:

We have the honor to present herewith the report prepared by the Commission on Instructional Technology.

This report is the result of the study requested in April 1968 by your predecessor, in response to Title III of the Public Broadcasting Act. However, in his first meeting with us, the Commissioner of Education broadened the scope of the study beyond the precise wording of Title III of the Act (a title for which a specific appropriation was not made) by saying:

> The scope of your work should be wide ranging. Every aspect of instructional technology and every problem which may arise in its development should be included in your study.

In the light of this mandate, the Commission has concerned itself with the whole gamut of instructional technology -- old, new, and future; mechanical and electronic; automated and cybernated; from innovations in print technology to computers; from classrooms to multimedia centers.

In addition to investigating the status and potential of each medium, the Commission has studied instructional technology as a whole -- as a system greater than the sum of the various media. Throughout the study, our focus has been on the potential use of technology to improve learning from preschool to graduate school to adult education.

WHAT IS INSTRUCTIONAL TECHNOLOGY?

"Instructional technology can be defined in two ways. In its more familiar sense, it means the media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbook, and blackboard. In general, the Commission's report follows this usage. In order to reflect present-day reality, the Commission has had to look at the pieces that make up instructional technology: television, films, overhead projectors, computers, and the other items of 'hardware' and 'software' (to use the convenient jargon that distinguishes machines from programs). In nearly every case, these media have entered education independently, and still operate more in isolation than in combination.

The second and less familiar definition of instructional technology goes beyond any particular medium or device. In this sense, instructional technology is more than the sum of its parts. It is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction. The widespread acceptance and application of this broad definition belongs to the future." (From Chapter II, p. 27.)

* * *

Note: The quotations included in the report were selected to illustrate the range of judgments and opinions about instructional technology, and do not necessarily represent the views of the Commission. The quotations are reprinted by permission of the authors, and are subject to the usual copyright restrictions; all rights are reserved on behalf of the authors. The boxed examples, unless otherwise attributed, were compiled by the staff from various sources including their own observations.

The repetition, sometimes verbatim, of ideas and statements in the report is intentional in order to make each section of the report complete in itself.

Appendices A through E deal with specific aspects of instructional technology and are intended for the reader interested in further details on such matters as cost or the application of technology to special educational problems.

SUMMARY

The Commission on Instructional Technology was established in the belief that technology, properly supported and wisely employed, could help meet some of the nation's most pressing educational needs. The Commission's task was to determine, in a study lasting more than a year, whether this belief in technology's value for education is justified; and, if it is justified, to recommend to the President and the Congress specific actions to provide for the most effective possible application of technology to American education.

The Commission took as the starting point of its study not technology, but learning. The heart of education is the student learning, and the value of any technology used in education must therefore be measured by its capacity to improve learning.

But today, we observed, learning in our schools and colleges is increasingly impeded by such troubles as the growing gap between education's income and needs, and the shortage of good teachers in the right places. Formal education is not responsive enough: the organization of schools and colleges takes too little account of even what is now known about the process of human learning, particularly of the range of individual differences among students. This condition makes schools particularly unresponsive to the needs of disadvantaged and minority-group children. Moreover, formal education is in an important sense outmoded -- students learn outside schools in ways which differ radically from the ways they learn inside school. Educational institutions make scant use of the potent means of communication that modern society finds indispensable and that occupy so much of young people's out-of-school time.

Today technology touches only a small fraction of instruction. Colleges, universities, and schools have been using television, films, computers, or programed texts in instruction, but to a limited extent. The results are mixed, with some institutions making a creative and sustained use of the new media while others, after an initial burst of enthusiasm, quickly lose interest.

Examining the impact of technology on American education in 1969 is like examining the impact of the automobile on American life when the Model T Ford first came on the market. The further ahead one looks, the more benefits technology seems to hold out for education. The Commission weighed future promise against present achievements, and examined the discrepancies between the science-fiction myths of instructional technology and the down-to-earth facts.

Obviously, the problems that confront education have no one solution. But learning might be significantly improved if the so-called second industrial revolution -- the revolution of information processing and communication -- could be harnessed to the tasks of instruction.

On the basis of present experience and informed projections, the Commission believes that technology could bring about far more productive use of the teacher's and the student's time. Of particular importance is its capacity to provide instruction that is truly tailored to each individual student; the traditional resources of teacher and textbook are not sufficiently flexible by themselves. Moreover, technology could help educators base instruction more systematically on what is known about learning and communication, not only guiding the basic research, but also providing the strategies for applying research findings.

There are other reasons for harnessing technology fully to the work of schools and colleges. New forms of communication give man new capacities. Instructional technology could extend the scope and power of instruction. It could help to bridge the gap between the outside world and the school, thus making learning more immediate and more relevant. Perhaps technology's greatest boon could be to make education more democratic. Access to the best teaching and the richest opportunities for learning is inevitably inequitable because of the constraints of economics, geography, or other factors having nothing to do with a student's ability to learn. Through television, film, and other forms of telecommunications, however, the remote rural college and the hard-pressed ghetto school could share the intellectual and esthetic advantages of the best institutions and the richest community resources.

In the conviction that technology can make education more productive, individual, and powerful, make learning more immediate, give instruction a more scientific base, and make access to education more equal, the Commission concludes that the nation should increase its investment in instructional technology, thereby upgrading the quality of education, and, ultimately, the quality of individuals' lives and of society generally.

Our study has shown that one-shot injections of a single technological medium are ineffective. At best they offer only optional "enrichment." Technology, we believe, can carry out its full potential for education only insofar as educators embrace instructional technology as a system and integrate a range of human and nonhuman resources into the total educational process.

To achieve such improvements, the knowledge of how people learn must be deepened, and the capacity to put that knowledge to effective use must be augmented. In the process the organization and governance of the entire educational enterprise may well have to be changed. So may the preparation and deployment of professionals and other highly trained specialists. To make instruction productive and responsive to individual students, the barriers that stand between the formal institutions of education and the larger community may have to be breached.

The changes required will probably be as thoroughgoing as those which industry underwent when it shifted from hand labor to mechanization. But a society hurtling into the age of the computer and the satellite can no longer be held back by an educational system which is limping along at the blackboard-and-textbook stage of communication.

The six recommendations proposed in Chapter V of this report comprise the initial steps which the Commission on Instructional Technology considers essential, beginning with a new agency to provide leadership and focus for concerted action. Recommendation #1 would establish the National Institutes of Education (N.I.E.) within the Department of Health, Education, and Welfare, with broad authorization to support and fund greatly strengthened programs in educational research, development, and application. The N.I.E. would consist of several constituent institutes, and through them make grants to universities and other independent research institutions, as well as conduct research itself. It would also sponsor several strong autonomous centers for research, development, and application, and a few comprehensive demonstration projects.

A National Institute of Instructional Technology (N.I.I.T.) should be established within the National Institutes of Education to work closely with existing agencies concerned with instructional technology and to establish such other regional centers and programs as it deems necessary (Recommendation #2). It would concentrate on research, development, and application of technology. One of its chief functions would be to encourage the production of a wide variety of good instructional materials.

The proposed National Institute of Instructional Technology should also take the lead in searching out, organizing, and preparing for distribution high-quality material, in all media, needed to improve education (Recommendation #3). To this end, the N.I.I.T. should consider establishing a center or "library" of educational resources. The center would take on additional responsibilities, such as helping school and college libraries transform themselves into comprehensive learning centers.

Projects to demonstrate the value of technology for instruction (Recommendation #4) would be initiated by the National Institute for Instructional Technology. These projects would concentrate funds and other resources on a few carefully selected communities or school districts, with the emphasis on pockets of poverty or minority-group deprivation. The school system of the District of Columbia might be invited to mount the first of such model demonstrations.

Improving the capacity of educators to make good use of technology would be a major function of the proposed National Institute of Instructional Technology. Recommendation #5 proposes the support of programs, based on stepped-up research and development, to train and retrain teachers, administrators, and a variety of specialists.

Recommendation #6 proposes a mechanism whereby the National Institute of Instructional Technology could bring education and industry together in a close working relationship to advance the effectiveness of instruction through technology.

The Commission has concluded that only the federal government can undertake the major responsibility for the expenditures for basic and applied research, development, and application required in the years immediately ahead. Furthermore, we believe that the minimum initial financing required to carry out the recommendations of this report is approximately $565 million. Of this about $150 million would be required to launch the National Institutes of Education and the National Institute of Instructional Technology. The remaining $415 million would be required for the first full year of operation, including approximately $250 million for the research, development, and application activities of the institutes, $25 million for the center or "library " of educational resources, $100 million for demonstration projects, and $40 million for the training of personnel.

The aggregate amount suggested would equal no more than 1 percent of the projected total expenditures for American education in fiscal 1972.

* * *

In October 1968, before his election, President Nixon proposed the creation of a National Institute for the Educational Future. Mr. Nixon said: "This institute will take us into the space age in education. We are on the threshold of great changes, many brought about by the possibilities inherent in new technology."

The Commission believes that its proposals will help achieve this vision.

Chapter I

FOCUS ON LEARNING

Dissatisfaction with American education is everywhere evident. Opinions as to what should be done often contradict each other. But there is a clear demand for action that will enhance the learning of the individual student, the effectiveness of schools and colleges, and ultimately the quality of the nation's life.

Since the late fifties, the federal government has granted billions of dollars to finance curriculum reforms, innovations of all kinds in thousands of schools, and a large program designed specifically to improve the instruction of the disadvantaged. Yet the outcome of much of this endeavor and expenditure has been, to put it mildly, disappointing. All too often innovations have been alterations in form rather than substance, soon to be dropped in favor of a later model.

More recently, radical critics (and many students) have begun to question the axioms of American education, suggesting revision of the compulsory education laws, competitive alternatives to the public schools, and abolition of traditional instructional procedures. Maverick educators have set up freedom schools, street academies in the big-city ghettos, schools without buildings or classrooms or conventionally organized programs.

But for all the fanfare, effort, money, and good will, the generality of schools and colleges is much the same as it was a generation ago. Many people, educators included, have come to the conclusion that fundamental and far-reaching changes must be made.

> The establishment in lower and secondary education is probably the most encrusted in the entire world. They still are teaching children as we were taught thirty years ago. A child today who comes into kindergarten has had from 3,000 to 4,000 hours sitting in front of that television tube, absorbing unstructured data that takes him way past Dick and Jane. And the system just doesn't respond to that.
>
> Robert H. Finch
> Secretary of Health,
> Education, and Welfare

The crisis in education has been a long time building. The iceberg image is unavoidable: most of the troubles have been with us for years -- but nine-tenths submerged beneath a sea of public complacency and preoccupation with other matters. Today, however, no one can ignore the problems which are pressing in from every side.

To some extent the schools and colleges are victims of conditions beyond their control: rapid population growth and mobility, country-to-city migration, unpredictable economic and social changes wrought by technology, disproportionate military claims on the gross national product. Added to these are the pervasive malaise and uncharacteristic self-doubts manifest today in America especially among the young, a condition resulting from many factors -- a long, unpopular war, poverty amid affluence, the bitter harvest of protracted racial injustice, and the menace of crime and violence. If education is sometimes made the scapegoat for the ills of society, the reason lies partly in the faith that most Americans from Jefferson's day to the present have had in the importance and power of education.

> Certainly it is not possible to spend any prolonged period visiting public-school classrooms without being appalled by the mutilation visible everywhere--mutilation of spontaneity, of joy in learning, of pleasure of creation, of sense of self. The public schools -- those "killers of the dream," to appropriate a phrase of Lillian Smith's -- are the kind of institution one cannot really dislike until one gets to know it well.
>
> Because they take the schools so much for granted, adults fail to appreciate what grim, joyless places most American schools are, how oppressive and petty are the rules by which they are governed, how intellectually sterile and aesthetically barren the atmosphere, what an appalling lack of civility obtains on the part of teachers and principals. The fact is that schools are not organized to facilitate learning (and certainly not joy in learning); they are organized and managed so as to facilitate order.
>
> Charles E. Silberman, Director
> The Carnegie Study for
> the Education of Educators

Against this troubled background the Commission on Instructional Technology was appointed and assigned its task -- to examine the instructional uses of such media as television, computers, tapes, radio, and their relation to each other. Implicit in this charge may have been the hope that here, in the technology that had made America one of the most affluent and powerful nations in history, could be found the magic to transform American education. But the rationale for the Commission's study was more modest and realistic: the belief that technology, properly supported and wisely employed, could help meet some of the nation's most pressing educational needs.

The Commission's aims were:

a. To determine whether in fact this belief in technology's value for education is justified;

b. If it is justified, to recommend to the President and the Congress specific actions that may be taken to provide for the most effective possible application of technology to instruction.

Means and Ends

The Commission's mandate concerned the means of instruction -- especially such newer means as television or computers. But in education as elsewhere means are inextricably involved with ends.

How can powerful means of instruction play their proper role in achieving desired ends, both the broad purposes of education and the proximate goals of classroom instruction, without becoming the dominant factor in the mixture? Technology has a way of shaping the ends it ostensibly serves. To date, man has not been entirely successful in harnessing the machine to humane ends. Instead, technological society has at times subjugated human values to mechanical efficiency. It has adjusted men to machines rather than machines to men, permitted communications media like television to stablize at a low level, allowed industry and the automobile to foul and choke and scar the environment.

Are educators so conscientious and clever that there is no need to fear similar misuses of technology in education? It would hardly seem so. The dangers of dehumanization are as real for education as they are for other social institutions if schools and colleges fall prey to a technological order in which means determine ends.

As the current scene attests, there is also the constant need to make the *reality* of schools and colleges come closer to education's goals. Much of the pervasive student dissatisfaction today appears to stem from such discrepancies as those between the rhetoric of college catalogs and what actually takes place day after day in the classroom. Indeed, some critics hold that American education is already dehumanized without technology.

In determining the proper direction for America's educational institutions, the answers must be sought across the total spectrum of human interest, experience, and value. There is no single goal of education. Its purposes are many, to match the pluralistic structure of America itself.

Education should be concerned first with the well-being of the individual student and his capacity for a productive and happy life as a person and as a worker. But education must also be concerned with the well-being of the nation: its economic and social integrity, its political wisdom, its security and survival and growth. It must be concerned with the intellectual, artistic, and spiritual values by which men live and by which their judgments are made and their purposes defined. Education must help to answer the all-important question of how to achieve and preserve a genuinely free society in which men are authentic persons who are masters rather than slaves of the forces which help shape their world.

It is important to come to grips with these large matters in order to set the perspective and direction for schools and colleges. But instructional programs must also be shaped to fit more immediate ends, goals which lie within the reach of the student and teacher. The worth of instructional equipment, materials, and techniques must be judged in terms of their effectiveness in achieving these goals, as they relate to the basic types of personal experience -- feelings and actions, as well as thought.

Quite properly, the prime concerns of schools and colleges are thought, reason, and knowledge. But American education runs the risk of neglecting the noncognitive facets of life. Western culture has a long tradition of preoccupation with knowledge, reason, and abstraction, a habit of mind that has produced a verbal-conceptual type of education that relies heavily on language and language skills. The ability to use words and mathematical symbols and to engage in logical discourse with complex ideas is for us the chief mark of educational achievement. The inner life of feeling and appreciation, and the moral, esthetic, and spiritual values associated with that life, deserve far more attention than they commonly receive, especially in formal education.

he is trying to think
            to teach them to think
he tries it by a pond
to tell them why he likes it
to help them like it

he teaches them
he makes love to them
he dies with them a little

they ask no questions

after a while they all go away

"teechur,"
by Dick Higgins

In conducting our study we have tried to keep this imbalance in mind, looking for the potential values of instructional technology that go beyond the mere transmission of information.

Learning

Since the heart of education is the student learning, the value of any technology must be measured by its ability to facilitate learning. Learning therefore has been the Commission's touchstone throughout. All our studies, inquiries, research, and deliberations have begun and ended here: with the student as learner -- whether he learns by himself, with fellow students, through a teacher, or through some other agent. This emphasis is consonant with the most promising advances in education. "Less teaching and more learning" has been a goal of enlightened educators since Comenius pleaded for it in the 17th century.

> We have been making assumptions for centuries about how learning takes place, how it is motivated, and how the teacher should teach. I think we have reason to believe that most of those assumptions were wrong and that most significant learning has taken place despite teachers rather than because of them.
>
> One only has to reflect on the magnificent way the infant learns how to understand and speak his native tongue without formal instruction or systematic teaching systems. Later on, when he is learning to read, under systematic tutelage with specially designed materials and large amounts of time devoted to it, he has much greater difficulty, and less success.
>
> J. Richard Suchman
> Educational Consultant

The Commission's focus on learning disclosed three significant conditions:

IMPEDED EDUCATION	Learning in American schools and colleges is impeded by such troubles as the increasing gap between education's income and needs, and shortages of good teachers in the right places.
UNRESPONSIVE EDUCATION	The organization of schools and colleges take little account of even what is now known about the process of human learning, including the range of individual differences among learners and styles of learning. This condition makes schools particularly unresponsive to the needs of disadvantaged and minority-group students.
OUTMODED EDUCATION	The ways that students learn outside school differ radically from the ways they learn inside school. Formal education makes only limited use of the many means of communication which society at large finds indispensable.

Impeded Education

The factors which are impeding education will not yield to conventional remedies. To be sure, it would be a giant step forward if the nation could double or triple its educational budget, find the requisite manpower and leadership, and improve poor and mediocre institutions. Better-trained teachers and administrators, more modern facilities, better teaching materials in adequate supply -- there is no denying that sharply stepped-up outlays of time, money, talent, and effort could go far to improve education and alleviate some of its grosser inequities and more obvious failures. But "more of the same" -- or even "more of the same, but better" -- will not get at the root of education's troubles.

> Education is beyond repair. What is needed is radical reform. This reform is to include the nature of the schooling process, the systems which control educational policy, and the institutions which prepare persons to be teachers.
>
> Teachers for the Real World
> B. Othanel Smith, et al, for
> the American Association of
> Colleges for Teacher Education

If under present methods education is impeded, if present arrangements of time, space, teacher and student role are incapable of resolving the major problems facing American education, the answers must lie in fundamental change.

Unresponsive Education

Researchers in human learning agree that individuals differ markedly in the ways they learn, in the speed at which they learn, in their motivation to learn, and in what they desire to learn. But educational institutions cater only fractionally to these individual differences. Even in the best schools, where students' achievements in the three R's and the standard subjects are well above grade, and resounding percentages graduate from high school to enter college, many thoughtful educators and outside observers believe that institutions have lost touch with the individual student.

Most schools and colleges are still locked into conventional patterns of grade structure, time span, and subject-matter division that fail to exploit each student's individual capacities, interests, and personality. Conventional practice is geared to some abstract "average" or "norm" that penalizes both the unusually gifted and the seemingly backward student as well as the spectrum that lies between.

> Schools are graded as an administrative convenience. Such an organizational pattern merely permits us to obtain prettier and neater statistical tables. The question from the state superintendent is: "How many children in the second grade?" Answer: "400." So what? There is at least a four-year achievement span among these children, and any "second grade" teacher can attest to this. There is no such thing as a "second grade." Such nomenclature merely provides information for census studies or reports to the country. It has nothing to do with the education of children.
>
> Robert M. Finley, Superintendent
> Glen Cove Public Schools, New York

How then can conditions of learning be designed that effectively respond to the individual differences among learners? Although research has pointed up these differences, it has not yet provided adequate guidelines for the design of individualized instruction. One thing, however, seems clear: the traditional mix of teacher, textbook, and blackboard is not sufficiently flexible by itself to make learning an individualized process. Differentiated types of instruction -- with less rigid student groupings and a more flexible range of resources -- are essential.

Individualized instruction does not mean the end of group instruction. It means shaping instruction to the needs and styles of the learners and the requirements of the subject matter. Instruction geared to the individual calls for many different arrangements, from independent study to large-group instruction.

Outmoded Education

Today's students are deluged by electronic media and many types of audiovisual communications: television and movies occupy more of their waking hours than any other single activity including school. The transistor radio pounds at their ears with the rock rhythms and lyrics to which they respond as they seldom do to conventional music and poetry. The telephone, the mass-circulation magazine, the paperback book, the phonograph and tape recorder -- all are integral and intimate elements of their lives. They shape the ways in which young people think, determine whom they admire and whom they scorn, what and how they feel about love, war, life, death -- and about education.

> Children learn, from television and from the ads, just what is happening in the world, about the pill and IUD and organ transplantation and tissue propagation. They are learning about the possibility of test-tube babies while the schools are still cautiously producing a few carefully sterile remarks about reproduction.
>
> The prewar generation grew up trained to "concentrate," to work in quiet libraries where people were punished for talking, to finish their lessons before they played records or turned on the radio.
>
> The postwar generation has learned to read and study and think with several media going at once, TV showing a game with the sound turned off, the radio turned on to a radio commentator on the same game, a long-playing record providing background music, as ninth graders glued to the telephone compare notes on the problems they are doing.
>
> Margaret Mead
> Curator of Ethnology
> Emeritus
> American Museum of
> Natural History

As a result of this communications barrage, today's child has a world view entirely different from his parents'. To some observers, this change in sensibility makes formal education virtually obsolete as currently practiced. They argue that to compete for students' interest, educators must reconsider both what they teach and how they teach it. For example, the child who has absorbed the rudiments of space rocketry from live television broadcasts of the astronauts may not only resist covering the same topic in class; he may also find that other subjects seem pallid when presented by a harried, inexpert teacher unassisted by technology. Are we asking too much to insist that learning in school should be at least as interesting and relevant as the learning that goes on incessantly outside of school?

> The young of many countries continue daily to manifest revulsion against the traditional effort to contain the educational processes in the bureaucratic and homogenized spaces of existing schools and colleges and curricula.
>
> Young and old alike now live in unique service environments of information. It is a many-layered environment.
>
> The inner layers are the familiar electric networks of telegraph and telephone and radio and TV. The outer layers are jet and satellite.
>
> To go on building 19th century spaces for the storing and dissemination of classified information is perfectly natural. It is also fatal.
>
> Marshall McLuhan
> Director of the Center
> for Culture and Technology
> University of Toronto

Society employs a wide range of communications. America would almost stop functioning without telephones, computers, and jets. Communications technology has given man new powers that enable him not only to accomplish existing tasks more efficiently but also to undertake new tasks that were previously impossible. Space flights could not have taken place without the instantaneous computer calculations that control orbiting and reentry.

Learning and Instructional Technology

The multiple problems that confront American education have no single solution. But learning could be significantly improved if the technology and techniques of the so-called second industrial revolution -- the revolution of information processing and communication -- could be harnessed to the tasks of the schools and colleges.

> Can technology help the mediocre teacher or the one who really doesn't like young people? I suppose our major hope for computers and other technology is to compensate for the imperfections of those who can be trained to teach but who cannot be taught to be good teachers.
>
> John Caffrey, Director
> Commission on Administrative Affairs
> American Council on Education

Colleges, universities, and schools have been making a limited application of technology -- television, films, computers, teaching machines -- to instruction. How has this instructional technology fared? Has it shown the capabilities to tackle the complex problems of learning which can now be identified? Do the accomplishments of the various types of instructional technology justify the belief that "technology, properly supported and wisely employed, could help meet some of the nation's most pressing educational needs"?

Chapter II

INSTRUCTIONAL TECHNOLOGY TODAY

Examining the impact of modern technology on instruction in 1969 is like examining the impact of the automobile on American life in 1908 when the Model T first came on the market, or the impact of technology on farming a decade after the appearance of McCormick's reaper. Western man may now be entering the post-industrial age, but his children attend schools and colleges that are just catching up with the industrial age, and have scarcely been brushed by the communications revolution. Indeed, the very term "instructional technology" is unfamiliar not only to the public at large but to many teachers and administrators as well.

> Instructional technology is today largely supplementary to the two primary media of instruction: the textbook and the teacher. Eliminate either of these and the educational system would be transformed. Eliminate all of the technology, and education would go on with hardly a missed lesson.
>
> Norman D. Kurland, Director
> Center on Innovation in
> Education
> New York State Education
> Department

Instructional technology can be defined in two ways. In its more familiar sense, it means the media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbook, and blackboard. In general, the Commission's report follows this usage. In order to reflect present-day reality, the Commission has had to look at the pieces that make up instructional technology: television, films, overhead projectors, computers, and the other items of "hardware" and "software" (to use the convenient jargon that distinguishes machines from programs). In nearly every case, these media have entered education independently, and still operate more in isolation than in combination.

The second and less familiar definition of instructional technology goes beyond any particular medium or device. In this sense, instructional technology is more than the sum of its parts. It is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction. The widespread acceptance and application of this broad definition belongs to the future. Though only a limited number of institutions have attempted to design instruction using such a systematic, comprehensive approach, there is reason to believe that this approach holds the key to the contribution technology can make to the advancement of education. It became clear, in fact, as we pursued our study, that a major obstacle to instructional technology's fulfillment has been its application by bits and pieces.

Instructional technology, by either definition, includes a wide array of instruments, devices, and techniques, each with its particular problems, potential, and advocates. Note, however, that neither definition equates technology with "machines" -- an easy mistake to make. To put prime emphasis on equipment -- e.g., films, coaxial cable, teaching machines -- can lead up a blind alley. Many observers believe, for instance, that fascination with the gadgetry of instructional television to the exclusion of the idea behind it has often led to stereotyped and impoverished uses of that medium.

> Has all of this made any real difference in what teachers do in classrooms, in how instruction is managed, and in how children learn in classrooms today? One could be gentle and say that the answer, like the schools, is pluralistic. But anyone who knows teachers and teaching and who visits schools will report a negative answer. In sum, it has made very little difference. What God hath wrought -- from telegram to transistor -- man has made little use of in the teaching-learning process that persists today in the classroom.
>
> Robert C. Snider
> Assistant Director, Division
> of Educational Technology
> National Education Association

Instructional Technology: Myth and Reality

In addition to encountering different views on the meaning of "instructional technology," the Commission also encountered many different judgments on instructional technology's present and potential role in American education. The education profession and the general public have been bombarded for some time with rosy predictions of how technology could quickly transform our schools and colleges. Such visions have been characterized as "the myths of instructional technology" by Anthony G. Oettinger, a linguist and mathematician associated with the Harvard Program on Technology and Society. He describes himself "not as a Luddite fearful of the Machine nor as a shrinking humanist living in the past, but as a scientist and engineer convinced that educational technology holds great promise."

Of his recent book Run, Computer, Run Mr. Oettinger has written: "My aim in analyzing the myths, the institutional failures, the brazen exploitations, the oppressive self-delusions that make a mockery of technological change in education is not to deny the promise, but to rescue it from unmerited disillusionment. I say there are no easy victories, no quick answers, no panaceas. If we are to realize the promise, we must not allow our human and material resources to be diverted into showy changes in form that will continue to block change in substance. Fundamental ignorance remains to be overcome in many realms that bear on the successful application of modern technology to education and we must therefore be prepared to encourage long-term investment in the exploration of diverse paths."

With changes coming so fast, definitive judgments and projections are almost impossible. While there is a convincing case for instructional technology as a cohesive, promising new approach to the whole problem of improving learning, examples are limited and largely unevaluated.

> Technological devices already introduced into schools in recent years have had only peripheral impact, partly because educational technology is as yet much more primitive than is generally appreciated, so that fragile, unreliable, and expensive devices often gather dust in a classroom corner after an initial wave of enthusiasm has subsided.
>
> Knowledge about how to apply the technology is even more primitive, in a number of respects. Even when machines work and classroom attitudes are attuned to their use, attempts to graft the new techniques to old curriculums have proved spectacularly unsuccessful and largely unrelieved as yet by imaginative technical and curriculum innovation tailored to the new demands and possibilities of education.
>
> Emmanuel G. Mesthene, Director
> Harvard University Program on
> Technology and Society

In American schools and colleges today the major source of instruction other than the teacher in person is the book, plus such immemorial accessories as charts and blackboards. Consider this simple calculation. There are fifty million pupils attending class an average of five hours a day, five days a week. In the aggregate, for the nation as a whole, the total comes to about 1,250,000,000 pupil class hours a week. All the films, filmstrips, records, programed texts, television, and computer programs do not fill more than 5 percent of these class hours. Some experts put the figure at 1 percent or less. For higher education the estimated use of instructional technology is of the same order.

> Most theorists who have contributed to the best thinking and writing in this field, describe motion pictures in education as noncinematic, pedantic, ineffective -- produced by amateurs or unimaginative professionals for unimaginative educators who simply use dull films as substitutes for dull lectures.
>
> Robert W. Wagner, Chairman
> Department of Photography and Cinema
> Ohio State University

To generalize and oversimplify: the present status of instructional technology in American education is low in both quantity and quality. Rather than taking hold and gaining followers through successful demonstrations, many ambitious projects have faltered and failed. Rather than boldly exploring fresh strategies to stimulate learning, most projects have merely translated existing curricula and teaching techniques into the newer media. Rather than filling a functional role in a comprehensive approach to the design of instruction, most innovators have chosen or been forced to confine themselves to their own special medium or technique. Rather than moving into the center of the planning process in education, most technologically oriented educators are on its periphery.

> The chief problems of using satellites for education are now ground problems, not space problems. The hardware has outrun the software. The tools are so fascinating that we have tended to watch them develop and marvel at them and to neglect the more mundane and messier questions of how to use them.
>
> Wilbur Schramm, Director
> Institute for Communication Research
> Stanford University

On the quantitative side, statistics are sketchy and often inconsistent. Furthermore, without uniform criteria, it is often difficult if not impossible to make useful comparisons or to arrive at sound conclusions on changing patterns of use. There is a glaring lack of data reliably indicating the actual use of the various technological media, as against their mere availability in an institution. There is no doubt about the rise in the number of tape recorders, record players, projectors, and filmstrips available for use. But the Commission learned again and again, from school superintendents and media experts, about the widespread failure of instructors to use equipment and materials (including expensive installations such as language laboratories bought with newly authorized federal funds). "Gathering dust" was the recurring phrase for what has happened to a great deal of technological equipment.

The evidence on the quality of most available programs is equally dispiriting. For example, the National Instructional

Television Center, established a few years ago to winnow out and distribute good instructional television programs, found only a very small fraction of the programs scanned worthy of national distribution. Comparable judgments apply to most instructional media, from films to programed instruction.

> As long as television represents for the schools only a public-address system with pictures, there is nothing but casual mediocrity to be expected.
>
> John W. Meaney
> Professor of Communication Arts
> University of Notre Dame

But there are recent reassuring examples, too, of good programing and wise applications of instructional technology. Some of these examples are coming out of the Research and Development Centers and the Regional Educational Laboratories funded by the federal government. The best foreshadow what technology's full contribution might be to education: they integrate a range of media old and new, exploiting the special qualities of each; they are based on sustained research and development, with plenty of feedback from field testing to enable needed change and improvements to be made. Moreover, they are designed so that the results can be carefully evaluated.

The fact is, then, that instructional technology is a mixed bag. It can be anything from an audiovisual graveyard in the basement of some school, to a successful computer-assisted course in Russian, to the extensive instructional television network in South Carolina.

Twenty-two Stanford University students in an introductory Russian course during 1967-68 spent about 50 minutes a day, five days a week, at a computer console. A total of 135 lessons were specially prepared and presented to the students in a combined audio and teletype format. The students responded on a Model-33 teletype with a special keyboard containing the Cyrillic alphabet. During the period prior to the final examination, the computer assessed each student's performance and told him the areas in which he should concentrate his efforts. The student could redo any lesson or portion of a lesson at the computer console.

Costs of Instructional Technology

Any consideration of instructional technology in American education would be incomplete without a look at costs. Occasionally, technology saves money for schools or colleges -- for instance, when closed-circuit television makes up for unavailable art or music teachers (as in Washington County, Maryland) or reproduces the lecturer in multiple classrooms (as in a number of public universities which use television to handle overflow freshman and sophomore classes). Many believe that wide-scale use of certain kinds of technology, with corresponding reduction of initial investment costs and well-planned operating procedures, could effect economies in education. But a true technology of instruction that integrates human and nonhuman resources into a comprehensive system to improve learning is unlikely to save money. Quality comes high.

> More dollars are spent in one week for programing three major television networks than in a year for all educational television.
>
> Newton N. Minow, former
> Chairman, Federal
> Communications Commission

To date, costs of large-scale demonstration projects making extensive use of technology have been substantial. The Midwest Program on Airborne Television Instruction cost $18 million (1961-1965). The Children's Television Workshop, which will start broadcasting in the fall of 1969, has estimated the cost of its initial series of 130 one-hour television programs at $8 million, including developmental costs. The Education Development Center spent approximately $6.5 million to develop a single high-school physics course. It also spent about $3.1 million to develop its widely acclaimed series of films on fluid mechanics, and about $8.1 million for its elementary-school science course.

> The TV advertising budget for a fifty second commercial selling a headache tablet is larger than the annual budget for public television.
>
> Gabriel D. Ofiesh, Director
> Center for Educational
> Technology
> Catholic University of America

There are several factors which contribute to the high cost of instructional technology, on top of the large initial investment in complex equipment such as computers, television, and talking typewriters; specifically, the cost of:

1. Developing and testing high-quality programs.
2. Providing time for teachers to gain an understanding of technology, to learn the technical skills necessary, and to plan programs.
3. Employing media specialists and teacher aides.
4. Maintaining equipment.

Experiments which have not taken these factors into account have generally failed. Equipment too often wears out or succumbs to casual vandalism; no one is available to repair it quickly and few are willing to depend on it thereafter. Attempts to cut corners by not properly training teachers or by not hiring enough specialists can produce poor results or none at all. One teacher told the Commission that his school, a new institution fully equipped to integrate the most advanced technology into the curriculum, had to abandon the system after a year and a half because teachers were never trained in its use and technicians were lacking.

Today, the estimated costs of a computer-based instructional system, for example, vary enormously. While the cost of hardware can be approximated, estimates of the cost of effective, high-quality programs are meaningless until much more research and development work has been done. Professor Phil C. Lange of Teachers College, Columbia University, told the Commission: "Most of the figures that I see on computers just don't add up; the only way the figures do make sense is when there is an assumption of a statewide or regional monopoly using a standard curriculum for a fixed population."

There is an even more basic problem. The techniques of cost accounting used by educational institutions do not provide the necessary data. In general, schools and colleges conduct their business by methods that yield few valid measures to guide education's managers in choosing among a range of instructional options. John E. Dietrich and F. Craig Johnson of Michigan State University told the Commission:

> At present, cost data on educational technology are almost nonexistent. The lack of these data severely impedes the academic decision-making process. Regardless of costing procedures used, ways must be found to place costs of educational technology in perspective. Present inadequate cost data are frequently so subjective that they are nothing more than pious hopes. The time is here to come to grips with the reality of cost analysis in the academic decision-making process.

The effort to establish effective procedures for determining instructional costs must be mounted. Its purpose has little relation to that once vaunted "cult of efficiency" that sought to bring business methods to bear on inefficient schools. The purpose of sensible economic practice in education has less to do with efficiency than with effectiveness. It is a question of education's turning out the highest-quality product possible -- i.e., genuinely educated students -- for the funds, talent, and time expended in their education.

Diagnosis

High cost and inadequate costing techniques are clearly a major cause of instructional technology's lack of impact on American schools and colleges. There are other causes important to identify. Some are quite tangible, such as insufficient time, talent, and resources to produce effective and imaginative programs; the inaccessibility of whatever good materials exist; lack of specialists in instructional technology; inadequate preparation and in-service training of teachers and administrators; the tendency of some commercial firms to sell educators hardware designed for noninstructional purposes. Other causes are less tangible but more fundamental -- such as the lack of sustained, well-funded research and development in the teaching-learning process. Too little is known about how human beings learn, still less about how to apply what _is_ known to the instructional process.

> There is considerable "religiosity" associated with instructional technology -- those that are in the field seem to believe that the potential is just lying there waiting to be tapped. This reveals an underlying assumption: that the system is adaptable to instructional technology, and that operations in this area will be welcome. Such an assumption has not been wholeheartedly validated.
>
> Richard E. Spencer
> Professor of Educational Psychology
> University of Illinois

Obstacles to a more extensive use of instructional technology also include negative teacher attitudes, lack of administrative commitment, the pervasive conservatism of the education establishment. The application of technology to something as "human" as schooling smacks of sacrilege to many Americans, especially teachers. Their opposition, or at least ambivalence, may well have been aggravated by overemphasis on mass instruction, machines, and gadgetry, and by the expression "teaching machine" (now pretty well supplanted by "programed instruction").

Resistance to instructional technology among students and teachers appears to be in direct ratio to the grade level. This is borne out by observation as well as by such studies as have been made. Elementary-school children and teachers accept television or films far more readily than college students and teachers. ("I am a student. Do not fold, spindle, or mutilate," read the protesting campus signs.) Primarily, fears center around prospects of depersonalization, standardization, conformity, and the gradual elimination of whatever diversity now exists. High-school and college staffs are also constrained by rigid schedules, departmentalization, and to some measure by distrust of "outside" materials. Other negative attitudes toward instructional technology in both students and teachers stem not so much from visions of a dehumanized future as from actual unsatisfactory experiences with technology.

> In the Midwest a determined group of faculty members attempted to sabotage a newly installed computer system for recording grades by punching random holes in the cards used to report grades to the IBM machine. At yet another university an embattled registrar fought a proposal to introduce a streamlined computer registration system, arguing that his office could do the job more efficiently with traditional hand methods. Whether these reactions are justified or not, they serve as a reminder that institutions of higher education have begun to convert important segments of their administrative procedure to electronic computers and that the effects of this conversion are being felt in all quarters of the academic community.
>
> Francis E. Rourke and Glenn E. Brooks, The Managerial Revolution in Higher Education

A 1969 poll, conducted for Life by Louis Harris and Associates, Inc., showed a large majority of high school students and their teachers eager for innovations. Both groups, for instance, wanted more field work outside the school and more opportunities to work directly in the community. But, according to the poll: "One innovation got an overwhelming thumbs-down from the students: teaching by films and closed-circuit television. The reason, they said, was that it cast them in a passive role and froze out class discussion." Contrasting with this sampling are some earlier studies on student attitudes toward instructional television (at Pennsylvania State University, for instance, and other colleges) that show students taking a favorable or at least neutral attitude toward television teaching. Generally the research shows that college students prefer small discussion classes to television, but prefer television to very large lecture classes.

> There is a tendency among those working in the field of educational technology to assume that this is the only way to improve instruction and schools. I prefer an overall system that allows for alternate proven approaches, even if some of them are traditional. Look at some first-rate schools -- Bronx High School of Science (New York City) and New Trier High School (Winnetka, Illinois) might serve as examples -- and I suspect you will find that the human element, the human teacher, is still dominant.
>
> Mortimer Smith, Executive
> Director, Council for
> Basic Education

The Commission faced the basic question of whether instructional technology's poor showing to date is evidence that it does _not_ have potential value for improving education. Is education justified in resisting the advances of technology? The spectacular success of technology in multiplying productivity in other sectors of American society does not mean that it can or should do the same for education. The growing number of social critics who see technology's detrimental effects on American society (air and water pollution, scarred countryside, war machinery) fear that technology could have a comparable effect on education.

Indeed, if instructional technology merely provided more potent means of conducting education as usual, it would bring no great benefits. It should be encouraged only if it promises, on the basis of experience to date and on informed projections about the future, enhancement of students' learning and growth. The Commission therefore undertook to review that experience and examine those projections.

> We have become victims of our own technological genius. But I am confident that the same energy and skill which gave rise to these problems can also be marshalled for the purpose of conquering them.
>
> President Richard M. Nixon

Chapter III

INSTRUCTIONAL TECHNOLOGY TOMORROW

The further one looks ahead, the more benefits technology seems to hold for education. At the core of the crystal ball is instruction that is truly tailored to the individual student. Patrick Suppes, director of the Institute for Mathematical Studies in the Social Sciences, Stanford University, foresees the time when "millions of school children will have access to what Philip of Macedon's son, Alexander, enjoyed as a royal prerogative: the personal services of a tutor as well-informed and responsive as Aristotle."

Tomorrow's student might "get" his education not within the confines of school or campus, but wherever he happened or wanted to be. Videotaped lessons could be played on a home television set. The computer opens up vast possibilities. It is predicted, for instance, that computer terminals, including teletypewriters with cathode-ray visual displays, might be located almost anywhere. A "suitcase" terminal could be connected by telephone line with a central computer. The student might engage the computer in a program of remedial instruction, drill, self-testing exercises, or a Socratic dialogue.

A broad technological innovation likely to affect instructional technology in the next decade is holography. This photographic technique, which may employ lasers, records wave fronts of light from an object. These are then used to reconstruct an image of the object in true three-dimensional form. This will make possible three-dimensional photographs, printed illustrations, projected slides, motion pictures, televised pictures, images at computer terminals, and microscopic slides.

It is likely that in the next ten years breakthroughs in the use of lasers, improvements in data transmission, storage, and retrieval, will play a part in a more widespread and more sophisticated use of communications satellites for direct broadcasts to schools and homes. This, along with improvements in computers, tape players, and film projectors, will greatly increase the potential for individualized instruction in audio and video forms, programed and nonprogramed.

Hugh F. Beckwith, President
Beckwith and Associates

Television and satellite systems could turn the student into an eyewitness of all manner of instructive events. Whether it were a national election, a student rebellion, a moon shot, an African lion hunt, or a Guru convention, the student would be able to observe what was happening as it happened.

The "schools" of tomorrow might also use technology to cultivate not only the student's cognitive powers, but his esthetic and moral development as well. George B. Leonard, in Education and Ecstasy, foresees academic courses that would enhance, through seemingly extraneous material, the central nervous system's capacity to make connections which are not necessarily conceptual, factual, or symbolic. He predicts the use of the computer as an artistic tool in its own right, and forecasts its use to incorporate brain-wave information in the creation of a total learning atmosphere of color and sound.

> The day when we can alter the intellectual capacity of children, and maybe of adults, through the use of drugs may come pretty soon -- in all probability within ten years -- since we are likely to develop chemical or pharmacological means for enhancing learning before we fully understand the biochemical processes of the brain. Eventually there may be a whole arsenal of drugs, each affecting a different part of the learning process, e.g., acquisition of information, short-term memory, long-term memory.
>
> Seminar on the Chemistry of Learning and Memory, sponsored by the Institute for Development of Educational Activities, Inc., and the U. S. Office of Education

Another area ripe for change, say the forecasters, is information and library science. Tomorrow's information-seeker could query a system which could search a collective fund of global information, and deliver the answer within seconds. If a text were desired, it would be printed out. Educational managers would have access to up-to-the-minute information on student characteristics, behavior, and performance, as well as to the latest findings in learning research and to actual materials available for instruction.

> By proper planning and coordinated activity we can work toward a time when information is unrestrictedly and equally distributed to everyone, regardless of his location, status, or wealth. It may come to be considered one of the rights of man to have immediate access (by remote man-machine interfaces or the terminals of a network), wherever he is, to complete, correct, and undistorted information on any topic of his interest.
>
> James G. Miller
> Vice President, EDUCOM
> (Interuniversity Communications Council)

Such is the visionary, long-range prospect for achieving vast improvements in education through a full exploitation of technology. But the closer one focuses the telescope, the more clearly do the genuine obstacles, constraints, and flaws show up. Much of the confusion and fruitless controversy in this whole field, in fact, arises from the tendency to confuse the short-term outlook with the long-term outlook, and to use one inappropriately against the other. Thus, the long-range potential of computers in education encourages the advocacy of using equipment available but possibly unsuitable now. On the other hand, the failure of prototypes and poorly designed experiments encourages arguments that a particular medium -- or even technology in general -- has a limited potential for improving education in the future.

Even in the short run, however, instructional technology could strengthen our ability to deal with critical problems. For example, it could introduce an inspiriting change of pace and mode for the minority-group student in cases where the teacher, coming from a different cultural and economic background, fails to sympathize with him and his problems. It could help to accommodate students whose learning styles make them unresponsive to a solid diet of books and lectures. It could stimulate students who are accustomed to the kaleidoscopic diversity and excitement of out-of-school learning via television, radio, and recordings, and who are bored by conventional instruction.

Moreover, as a labor-intensive system, education is growing more expensive all the time without becoming more effective. With the vast repertoire of communications media available, it is high time instruction became more productive. If, as seems clear, some of the functions performed by human beings can be performed as well or better through other agencies, teachers could assume more versatile, differentiated, human roles in the schools.

> A human being should not be wasted in doing what forty sheets of paper or two phonographs can do. Just because personal teaching is precious and can do what books and apparatus can not, it should be saved for its peculiar work.
>
> Edward L. Thorndike (1912)

Various innovations have been introduced as ways to break out of the rigid system which marches students, lock-step fashion, through a series of identical classrooms in which teachers do most of the talking and students have little opportunity to respond. Among these innovations are team teaching and teacher aides, non-graded elementary and secondary schools, independent study, curricula focused on helping students discover things for themselves rather than on trying to tell them everything, and schools designed for maximum flexibility so that students can work alone, or in small groups, or take part in large-group instruction via diverse media.

The aim of all these innovations -- organizational, curricular, and technological -- is to adapt instruction more precisely to the needs of each individual student. Many people who have an aversion to organizing instruction scientifically and to bringing new technology into the schools and colleges fail to realize that the present system is in many respects mechanical and rigid. The vast differences in the ways students learn are disregarded when they are taught the same thing, in the same way, at the same time. There is no escaping the evidence that many students themselves feel little enthusiasm and even outright hostility for the present way schools and colleges are organized and instruction is handled. Many of them resent technology, but what they object to is usually technology patched on as an expedient for handling a large number of students. Or it is programing which merely reproduces conventional classroom teaching.

What instruction requires is an arrangement of resources whereby the student responds and learns, reaching new plateaus from which to climb to higher levels of understanding. Implicit in such an arrangement, if it is to be effective, is the adaptability of the process to the individual student's differences -- in pace, temperament, background, and style of learning.

Technological media can perform many of the functions involved in this process:

- They can store information until it is needed or wanted;
- They can distribute it over distances to reach the student where he happens to be instead of bringing him to the teacher;
- They can present the information to the student through various senses and in many modes;

- They can give the student the opportunity to react to the material and respond in many ways.

In short, the student's opportunities for learning can be increased and enhanced by using a wide range of instructional technology. All the available resources for instruction, including the teacher, can work together to create conditions for maximum effective learning.

Much of the energy and intelligence which teachers currently expend in the classroom can be profitably shifted to working with students in tutorial and small group discussions, and to preparing potent materials which can then be stored, transmitted, and presented by nonhuman means.

> A machine is not a sadist and does not suffer from rebuffs or redundancy. Nor does a student feel demeaned by having to take instruction from a person of another class or race or sex. For a boy who feels that, like Huckleberry Finn, he must light out for the Territory to prove his manhood, or for a black student who feels that a white teacher is subjecting him to counterfeit nurturance and thus making him even weaker and more deprived, or for a lower-class white student who feels a similar uneasiness at being helped, the machine can be a marvelously neutral substitute.
>
> Few teachers are sadists; they are, however, human and naturally react to the adverse reactions of students and to the constraints of conventional school organization. The machine can spare both student and teacher.
>
> David Riesman
> Henry Ford II Professor
> of Social Sciences
> Harvard University

Many people see instructional technology primarily as a way of recording, storing, transmitting, distributing, and displaying material. But equally important is its capacity for response and feedback and for reinforcement of learning. Some of the most fruitful uses of technology for instruction aim at carrying out these functions, in ways which may be beyond the capability of the teacher. Programed learning, for example, provides immediate, constant, and infinitely patient feedback. Another quite different example is the use of videotapes in teacher education ("micro-teaching"), which gives teachers a new way to see themselves, to analyze small units of their own teaching, and to improve their methods as a result.

The Benefits of Instructional Technology

On the basis of present and past applications of instructional technology, and of informed projections by educators, scholars, and specialists, the Commission has summarized the potential benefits of instructional technology as follows:

1) TECHNOLOGY CAN MAKE EDUCATION MORE PRODUCTIVE

With the demand for education outstripping education's income, more effective and efficient learning is vital. Instructional technology has shown its ability to speed up the rate of learning. It can help the teacher make better use of his time. It can reduce the teacher's heavy burden of administrative tasks and take over some of the teacher's routine job of information transmission.

Thus, the teacher would be able to spend more time on teaching -- inspiring students to learn and encouraging them to apply newly acquired information in useful and interesting ways.

> At the U. S. Navy's Memphis Air Training Center, where 25 courses use programed instruction, training managers reduced training time by 28 percent after introducing programed instruction and saved 235 man years in 1968 alone. At Fort Rucker, Alabama, the United States Army Aviation School redesigned the entire Helicopter Instrument Flight Course by converting academic instruction to programed format and adapting the technique of programed, self-paced instruction to flight and synthetic flight training. This redesign resulted in a significant reduction in course length.
>
> Lt. Col. Howard B. Hitchens
> Professor of Instructional
> Communications
> U. S. Air Force Academy

2) TECHNOLOGY CAN MAKE EDUCATION MORE INDIVIDUAL

Group-paced and group-prescribed instruction seems to be a virtual necessity when resources are restricted to teacher and textbook. But technology properly applied opens up many different ways of learning. Individual differences can be taken seriously. The traditional rigid control and standardization of what students learn, how they learn, when and at what pace, is no longer necessary. One teacher per thirty students no longer has to be the dominant pattern for the public schools. The live lecture as the most common medium of instruction in higher education can now be questioned. Different combinations of teachers, students, materials, space, time, and dollars can respond more to actual learning needs and less to administrative convenience.

Freedom and self-direction have always been accepted as goals of American education. The use of technology in education can increase the alternatives and permit the student to find his own direction more easily. The pluralism of educational objectives in a democratic society can only be reached by using a plurality of means.

> A freshman botany course at Purdue University has been totally restructured with the aim of defining clearly all objectives. Students, teaching assistants, and academic and research colleagues have been consulted extensively, and all identifiable "busy work" has been eliminated. Most of the factual information is acquired through independent study in a specially designed learning center containing thirty booths. Each is equipped with a tape player, an 8mm movie projector, a microscope, live plants, test tubes, diagrams, and other materials pertinent to the week's study.
>
> Learning activities may include listening to short lectures, performing experiments, reading from texts and journals, studying demonstrations, viewing short films, discussions with the instructor and/or other students, microscope study, dissection of specimens, and any other study activity deemed helpful by the senior instructor or the student. Since the independent study is unscheduled, experiments do not have to be designed to fit into a three-hour time interval, and some experiments can take the form of miniature research projects.
>
> S. N. Postlethwait
> Professor of Biological Sciences
> Purdue University

3) TECHNOLOGY CAN GIVE INSTRUCTION A MORE SCIENTIFIC BASE

Instructional technology could provide the framework necessary for designing conditions of learning that are more closely based on what is known about how human beings learn. Research reveals, for example, the importance of reinforcement and reward in furthering learning: instructional technology can help make reinforcement and reward an integral part of learning. Instructional technology has the potential not only to guide research into asking the right questions, but also to apply research results to schools and colleges.

Oakleaf Elementary School, located in a blue-collar suburb of Pittsburgh, has been operating an individually prescribed instruction program (IPI) since 1963. Research and development for the IPI curriculum originated in the federally funded R&D Center located at the University of Pittsburgh. The purpose of IPI is to enable each student to go through the curriculum at his own speed, working independently much of the time. Courses thus programed are math, science, reading, and writing.

At Oakleaf, the system is learner-centered and the role of the teacher has been sharply redefined. Little of the teacher's time is spent in lecturing to a group. Much of the information transmission takes place independently of the live teacher -- through the media of booklets and worksheets and, in science, audiotape cartridges and three-dimensional manipulative equipment. The teacher's main tasks are evaluating individual pupils' progress, preparing daily learning prescriptions for each child, and tutoring children on a one-to-one or small group basis.

4) TECHNOLOGY CAN MAKE INSTRUCTION MORE POWERFUL

New forms of communication give man added capability. Instructional technology can extend the possibilities of education. The live teacher cannot "say everything." A physical-education film using slow motion photography, a recording of diseased heart beats, or a videotape of a presidential press conference enables the teacher to communicate more to the learner.

The study of the 20th century need no longer be so dependent on written documents when technology enables the student to see New York City in the 1920s, or the battle of the Somme, or a Hitler speech in the Berlin Sports Palace. By stressing instruction through teacher and textbook alone, formal education has become overly verbal. Many students -- particularly poor or minority-group children -- are thus handicapped in their academic progress, finding themselves ill at ease with the kind of language, oral or written, which they encounter at school.

> Teachers at our high school are committed to the concept that their students want to learn. So we took a careful look at their learning styles and turned to, among other things, the Tube. Our students watch as much as five hours a day, and they like it. It occupies their minds. And because that is precisely what we sought to do, many of the staff turned to TV. Closed-circuit television turned out to be an educational goldmine, for it allows us to address ourselves to our students' cry for relevance, to their surging interest in their identity as black Americans. It gives us a vehicle which capitalizes on how our kids like to learn and how they learn most readily.
>
> Marcus Foster, former principal
> Simon Gratz High School
> North Philadelphia

5) TECHNOLOGY CAN MAKE LEARNING MORE IMMEDIATE

Instructional technology can help to bridge the gap between the world outside and the world inside the school. Television and xerography can bring immediacy to the learner. They can make possible a dynamic curriculum. If instructional technology is creatively applied, the student's route to knowledge and understanding can be more direct.

Knowledge and reality, filtered through the words of textbook and teacher, all too often reach the student as predigested conclusions, neatly packaged, and thoroughly divorced from what Alfred North Whitehead called the "radically untidy, ill-adjusted character" of reality.

"First-hand knowledge," Whitehead wrote, "is the ultimate basis of intellectual life. To a large extent book-learning conveys second-hand information, and as such can never rise to the importance of immediate practice. Our goal is to see the immediate events of our lives as instances of our general ideas."

It would, of course, be idle to interpret Whitehead's words as a wholesale attack on books and a prescient endorsement of television. Nonetheless the words quoted above are typical of educational philosophers' constant plea for immediacy and diversity, qualities which the newer media of instruction can bring to formal instruction.

In the spring of 1968, 17 ETV stations on the East Coast, 495 teachers, and 13,650 students participated in a live, interconnected educational simulation involving telephone feedback from classrooms during the broadcasts. "Cabinets in Crisis," developed by the Educational Division of WGBH-TV in Boston, was a simulation of the Yugoslav aid crisis of 1950. Political decision-makers in the United States, the Soviet Union, and Yugoslavia were played on television by students in Philadelphia, Rochester, and Boston. "Political advisors" in the classrooms communicated advice and votes to the TV studio teams by telephone and letter. The staff of WGBH reported to the Commission that participation and interest ran high:

"A group of students from Boston became so involved they came to the studio when it was all over and announced they could construct a much better TV simulation. We encouraged them to work on it during the summer and they have come up with an original simulation which is in fact an improvement on our first experiment."

6) TECHNOLOGY CAN MAKE ACCESS TO EDUCATION MORE EQUAL

Equal access to rich learning environments is not possible without some recourse to technology. Through television or film nearly every school in America can have the luxury of seeing Sir Laurence Olivier play Othello. When the telecommunications network envisaged by the Interuniversity Communications Council (EDUCOM) is operational, the students and faculty of a small rural college can have direct access to the greatest libraries of the country. At the present time, via the National Library of Medicine's Medical Literature Analysis and Retrieval System

(MEDLARS), doctors in Denver can obtain as much bibliographic information on recent medical literature as can doctors working in the hospital across the street from the computer center in Bethesda, Maryland.

> Harvard has a beautiful Russian History Center and Pennsylvania has a beautiful South Asia Center. If I were in Pennsylvania and I wanted to know something about Russian history, obviously the best professor is at Harvard. But I can't see him.
>
> There is no reason why the federal government couldn't allow the educational TV stations to get telephone wires at a lower rate than the networks pay, so that I could listen to that lecture whenever they give it at Harvard -- listen to it in Pennsylvania and have everybody on the Coast listen to it. Right now it costs too much money.
>
> Richard Clarke, freshman
> University of Pennsylvania
> CIT student seminar

Technology does not have to move people; it transmits the impact of people. The limits to improving instruction through technology are political, parochial, financial -- they are not inherent in technology itself.

* * *

The Commission is convinced that technology properly employed could make education more productive, individual, and powerful, learning more immediate, instruction more scientifically based, and access to education more equal. We have concluded, therefore, that this nation should make a far greater investment in instructional technology. We believe that such an investment will contribute to extending the scope and upgrading the quality of education, and that the results will benefit individuals and society.

> I believe that instructional technology offers unique and priceless opportunities to bring to every student in every classroom the kinds of knowledge, the kinds of experiences, the kinds of insights that can truly widen the dialogue and help find the common ground for solutions to our most pressing problems.
>
> Wilbur J. Cohen, former
> Secretary of Health,
> Education, and Welfare

What form should this investment take? How should instructional technology be employed? What magnitude of investment should be made?

Chapter IV

TO IMPROVE LEARNING

To improve learning through the application of instructional technology requires a course of action that will:

- Deal with root problems, such as the advancement of the knowledge of how human beings learn and the application of these findings to instruction in schools and colleges.
- Support sustained research, development, and application projects.
- Apply technology to the most critical problems in education.
- Encourage alternative approaches to the solution of any given educational problem.
- Concentrate resources on action programs of high visibility.
- Create conditions which encourage scholars and specialists from various fields to work together.

The Commission proposes a course of action to meet these requirements. Top priority should go to the expansion and improvement of educational research and development and to the application of research findings to important practical problems in education. Finally, the results must be packaged for effective use by the schools and colleges.

> It would seem that much of what we have so laboriously learned about educational theory and practice has been -- to say the least -- under-advertised, poorly packaged, and thinly distributed.
>
> Thus, our first goal must be to get the good, new ideas and practices into use -- and get them there quickly.
>
> James E. Allen, Jr.
> Assistant Secretary for Education and Commissioner of Education
> Department of Health, Education, and Welfare

The Commission was strengthened in its conviction of the importance of research, development, and application by the findings of earlier and concurrent inquiries into this field. Similar conclusions were reached, for example, in the recent study, Innovation in Education, by the Committee for Economic Development (CED), and in the 1966 Congressional report on automation and technology in education; in the findings of the Harvard Program on Technology and Society; by outsiders at odds with the establishment as well as spokesmen for such groups as the American Educational Research Association; by a committee of the National Academy of Education, and in recommendations proposed to this Commission by scholars, the professions, industry, instructional technologists, and practicing educators.

> The nation spends proportionately 20 times as much on health research -- and about 60 times as much on defense research -- as it does on education research.
>
> U. S. Office of Education

Advances in educational research, development, and application have been made in recent years, as the Committee for Economic Development report noted: "Much has been learned about relating subject matter to instructional goals, refining the techniques of explanation, cultivating the capacity for discovery, and defining other aspects of the learning process." But the Committee for Economic Development added that much more needs to be known "if the schools are to continue to move ahead." It emphasized the importance of development as industry understands the process, of better ways to measure and evaluate the quality of instruction, and of concerted efforts to package, disseminate, and apply significant findings and likely hypotheses. Research findings must be brought to the schools under conditions and in forms that make them useful. There is no point in disseminating ideas which are not packaged for practical use.

> We need a means of analyzing the needs of education on a systematic and national basis; and then of influencing the allocation of R&D resources according to these needs, whether the resources are in education itself, in nonprofit research organizations, or in industry. Further, whatever mechanism is developed for this purpose, it needs to be structured in such a way that the independence of local or state educational units is not jeopardized.
>
> Robert W. Locke and
> David Engler
> McGraw-Hill Book Company

Harold Howe II, when he was U. S. Commissioner of Education, described education's research and development needs to a group of businessmen interested in the education market. Before the "revolution" in education, however desirable, could get very far, Mr. Howe said, much more would have to be known about the educational process: man has barely scratched the surface of man's ability to learn. While warning his audience that no miracles were around the corner, he stressed the double role that technology could play in dealing with the unanswered questions -- both as an instrument of instruction and as a research instrument.

An agenda for educational research:

How can we reach the children of the slums, who have remained relatively untouched by traditional education?

How can we find out, for any group of youngsters, whether we are teaching them the right or wrong things?

Can those who learn well learn even more?

How can we decide, in view of the explosion of knowledge, what part of the whole field we ought to attempt to teach?

How do we reach those presently unmotivated to learn?

How do we evaluate and alter school organization?

How do we come to a real understanding of what intelligence is? And can intelligence be learned?

At what age should formal education begin? And do parents have a real job to do in this connection?

How do we improve the education of two million teachers without seriously interrupting their teaching careers?

How can we get the most out of the individual student's ability to teach himself?

Harold Howe II, former
U. S. Commissioner of
Education

Comprehensive Approach

Research, development, and application (R. D. & A.) should, the Commission believes, form the core of a comprehensive approach to the improvement of learning. This comprehensive approach should include more and better training of teachers, administrators, and instructional technologists; the production of better materials; improved methods of access to instructional materials in all media; and more fruitful relationships between education and industry (see the six recommendations in Chapter V of this report).

> The major issues in the use of technology in education, as I see them, reside not so much in the development of technologies as in the re-education of teachers and educators in the value of technology as an aid to instruction. When educators look at technology as a resource for developing new alternatives and individualizing instruction, rather than as a dangerous, mechanistic intruder, then the existing wealth of technological developments will have its desired effect upon the world of education.
>
> Dwight W. Allen, Dean
> School of Education
> University of Massachusetts

The problems confronting American schools and colleges demand a cohesive, concerted attack. It is not the parts of the educational system that must be improved; it is the system in its totality. The key remedy is not computer-assisted instruction or team teaching or nongraded classes or educational parks or instructional television: it is innovations like these wisely integrated with each other and with teachers and the more traditional resources of education that may make the difference.

> Systematic application of communications technology to education provides the basis for developing new and economical means for coping with important educational problems. Technology -- radio or television, for example -- can communicate material that is carefully organized, documented, and planned. When technology can share with the teacher the responsibility for making the lesson effective, opportunities open up for designing and carrying out new instructional strategies.
>
> William G. Harley, President
> National Association of
> Educational Broadcasters

There are dangers, to be sure, in focusing prematurely and unremittingly on the "big picture." A comprehensive systems analysis is hardly required to know what has to be done to improve a ghetto classroom where the windowpanes fall in on the students and where there are no textbooks for the first six weeks of school. In these ghetto classrooms pictured so vividly in the news, in novels, movies, and official reports, as well as in the suburban classrooms dissected by social critics such as John Holt and Edgar Friedenberg, in the colleges under increasing attack as sterile and irrelevant, in poorly equipped schools in the rural South, in predominantly Negro colleges, and in many other places -- there is much obvious, everyday work needed to make American education decent and equitable.

* * *

At the beginning of this report, instructional technology was defined as "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on findings from research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction." A significant improvement of learning depends on our ability to organize our efforts in accordance with this definition.

John W. Gardner, chairman of the Urban Coalition, said recently: "We have already developed and tested many of the ingredients of what will be a new era in education. But the pieces of the educational revolution are lying around unassembled. Perhaps in ten or twenty years we will be able to look back and find that these pieces have taken shape into one cohesive whole."

Much of the Commission's study has dealt, by necessity, with the pieces of this unassembled revolution. But the revolution must eventually be assembled if education is to generate its full benefits for American youth. The nation cannot wait. A massive effort, year after year for decades ahead, is needed. This conviction underlies the recommendations that follow.

CHAPTER V: RECOMMENDATIONS

RECOMMENDATION #1

WE RECOMMEND:

A new institution -- the National Institutes of Education (N.I.E.) -- should be established by Congress within the Department of Health, Education, and Welfare, reporting directly to the Assistant Secretary for Education.

The National Institutes of Education should be broadly authorized to develop, support, and fund greatly strengthened programs in educational research, development, and application (R. D. & A.).

The National Institutes of Education should comprise several constituent institutes, through which grants would be made to universities and other independent research institutions. The institutes would also conduct research themselves. The N.I.E. should sponsor, among other things, several strong autonomous regional R. D. & A. centers, plus a small number of comprehensive demonstration projects.

The proposed National Institutes of Education -- well-funded, broadly based, and building on present strengths and successful programs (public and private) -- would give concentrated leadership and direction to a national effort to improve learning and teaching at every level of education. The organization should start with a few component institutes focused on critical areas. This report proposes the creation of a National Institute of Instructional Technology (see Recommendation #2), including a center or "library" of educational resources (see Recommendation #3). In addition, the National Institutes of Education might create other institutes, as for instance one concentrating on learning research, one on teaching and curriculum development, and another on educational organization, finance, and management. A prime function of the N.I.E. as the parent body would be to ensure close cooperation and feedback among the institutes. Their provinces would obviously overlap and it is important to avoid perpetuating conventional and unproductive divisions.

Instructional technology simultaneously draws from and contributes to an underlying science of learning. The technology of instruction is shaped by, as it will shape, the purposes and the substance of education. Unless technological means are harnessed to humane ends, with full regard for individual diversity and needs, no real benefit will accrue to society -- indeed, the reverse is more likely.

Furthermore, instructional technology is integrally involved with the process of learning and the genuine individualization of learning. Any sharp distinction, then, between research and development in instructional technology, on the one hand, and research and development in the basics of education, on the other, appears to us to be arbitrary. In fact, this very division has contributed to the disappointing impact thus far of instructional technology -- so frequently heralded, so seldom realized down the years since 1913 when Edison proclaimed the motion picture as the prospective agent of complete school reform.

The National Institutes of Education and its component institutes would undertake a limited amount of research, development, and application themselves. This proportion should be relatively small, however -- perhaps 10 to 15 percent. The majority of the work should be executed through grants made by the institutes to selected institutions, both public and private.

The Commission recognizes the importance of conducting both basic and directed research. Basic research, in which the investigator is free to formulate his own questions, can lead to far-reaching discoveries which could not be defined in a blueprint for investigation. On the other hand, directed research, in which the questions are clearly structured, can be a powerful tool for achieving specific desired results.

Each institute should establish subsidiary research, development, and application programs, tied in closely with individual institutions and with existing and projected regional centers. The National Institutes of Education and its component institutes should work closely with state educational agencies, especially state departments of education, and with the Education Commission of the States.

To insure maximum effectiveness and influence, the National Institutes of Education should be a strong arm of the Department of Health, Education, and Welfare, reporting directly to the Assistant Secretary for Education* as shown in the following chart.

The National Institutes of Education should be headed by a director with outstanding qualifications appointed by the President and aided in policy making by a small strong top-level Advisory Board, composed of government and nongovernment representatives. Each constituent institute should also be headed by a highly qualified director. Together the Advisory Board and the directors would act as a council to coordinate the work of the N.I.E.

Through its national visibility and stature, the National Institutes of Education should build up educational research, development, and application throughout the nation. Everywhere -- in universities and school systems and state departments of education -- there are able, dedicated people working on new approaches

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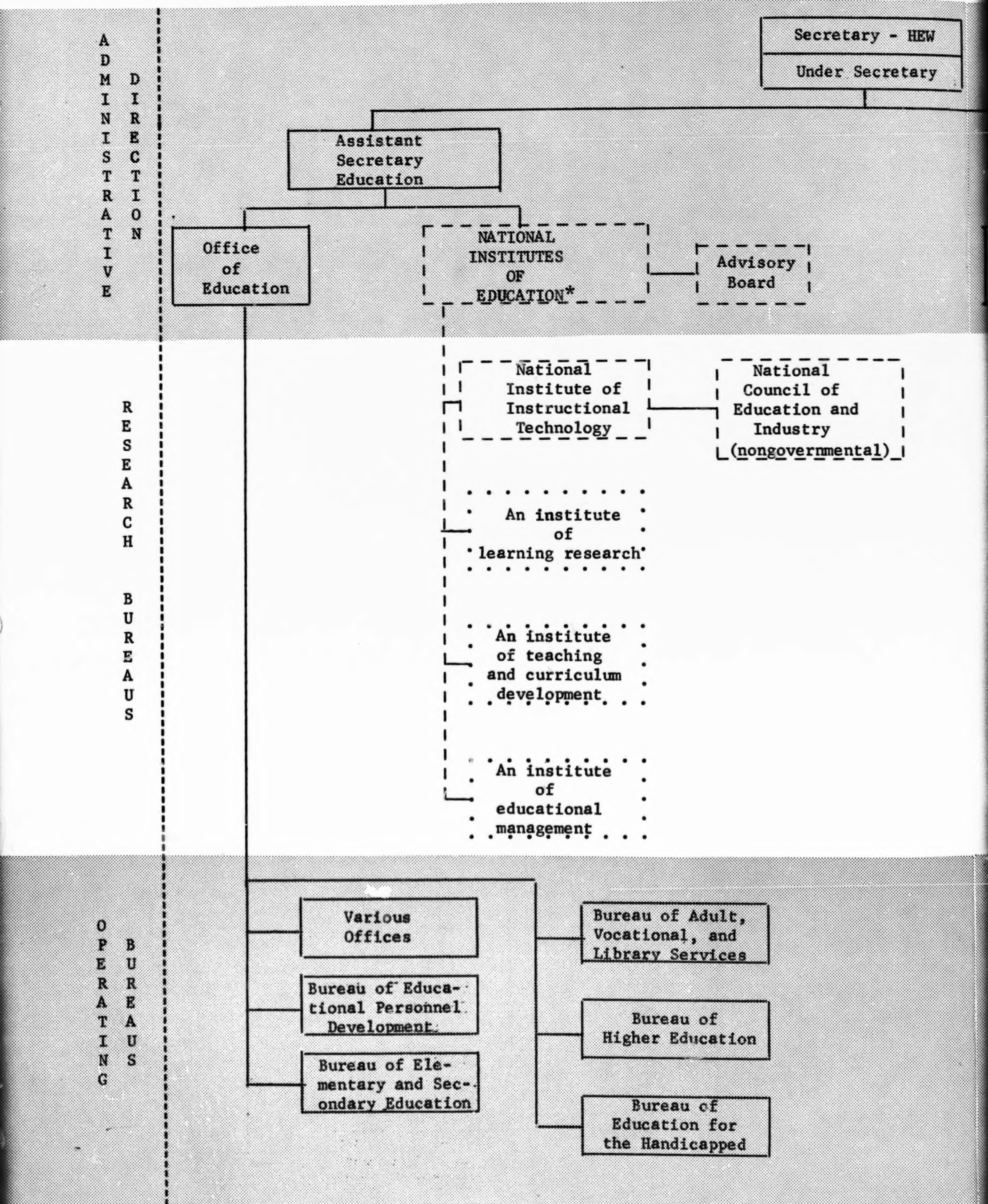
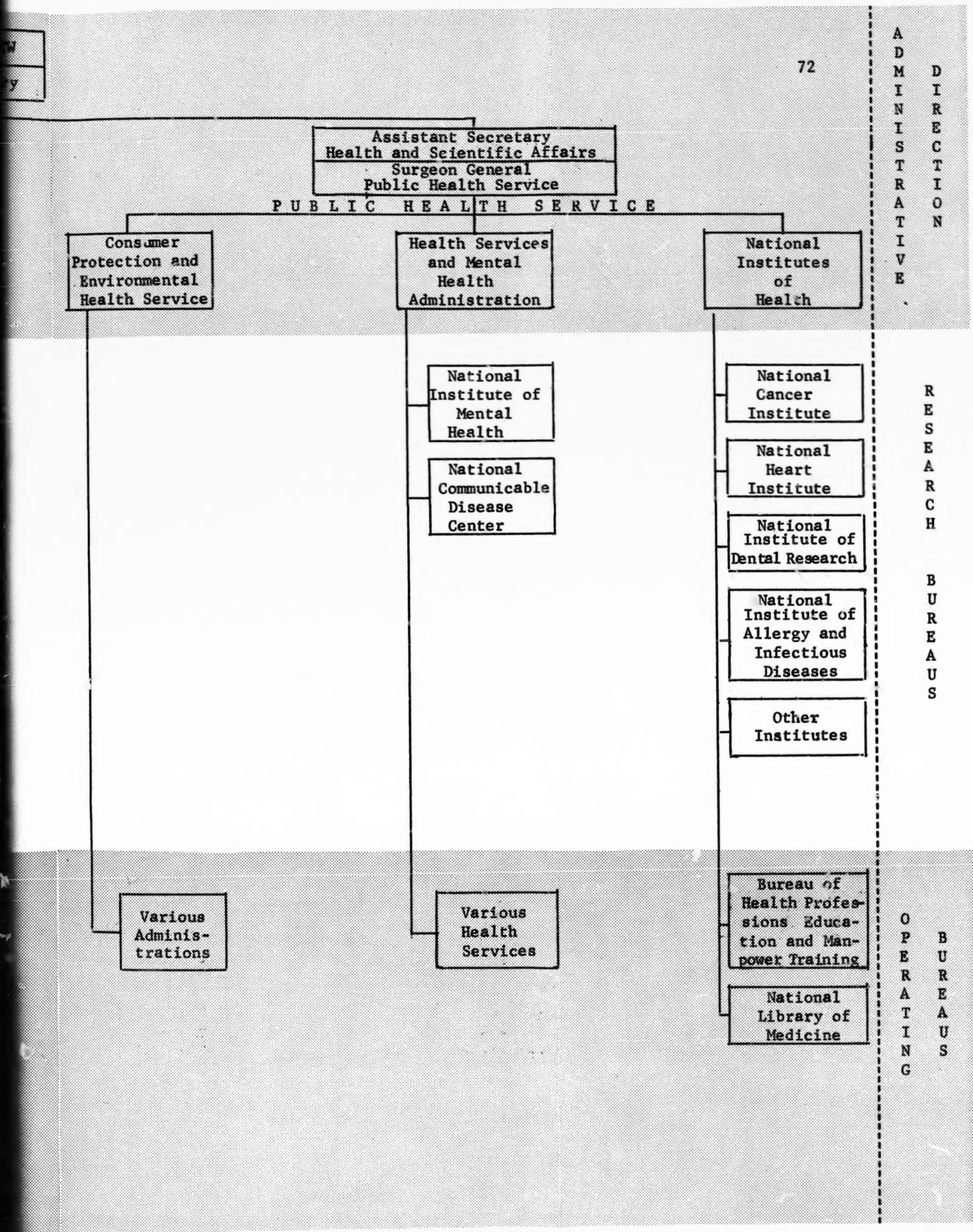
* Note: The Commission believes that the federal government's top official for education should be upgraded to the level of Under Secretary at least, and ultimately to a full Secretary, either under the Secretary of Health, Education, and Welfare or as head of a separate new cabinet-level Department of Education.


ADMINISTRATIVE DIRECTION
Secretary - HEW
Under Secretary
Assistant Secretary Education
Office of Education
NATIONAL INSTITUTES OF EDUCATION*
Advisory Board
RESEARCH BUREAUS
National Institute of Instructional Technology
National Council of Education and Industry (nongovernmental)
An institute of learning research
An institute of teaching and curriculum development
An institute of educational management
OPERATING BUREAUS
Various Offices
Bureau of Educational Personnel Development
Bureau of Elementary and Secondary Education
Bureau of Adult, Vocational, and Library Services
Bureau of Higher Education
Bureau of Education for the Handicapped

* Will incorporate the functions of the Bureau of Research.


W
y
Assistant Secretary
Health and Scientific Affairs
Surgeon General
Public Health Service
PUBLIC HEALTH SERVICE
Consumer Protection and Environmental Health Service
Health Services and Mental Health Administration
National Institutes of Health
National Institute of Mental Health
National Communicable Disease Center
National Cancer Institute
National Heart Institute
National Institute of Dental Research
National Institute of Allergy and Infectious Diseases
Other Institutes
Various Administrations
Various Health Services
Bureau of Health Professions Education and Manpower Training
National Library of Medicine
ADMINISTRATIVE DIRECTION
RESEARCH BUREAUS
OPERATING BUREAUS

to solving educational problems. The National Institutes of Education should strengthen promising work now going on, encourage initiative and invention, and support a diversity of approaches to critical problems. In Recommendation #2 we indicate how one of the institutes -- the National Institute of Instructional Technology -- could accomplish some of these objectives.

Tradition of Federal Research, Development, and Application Leadership

The establishment of a federal institution such as the National Institutes of Education would be entirely in the mainstream of American tradition. There are outstanding precedents for federal action of this magnitude in other fields. For instance:

> Agriculture: Since 1862, when President Lincoln signed the Congressional acts creating the U. S. Department of Agriculture and the land-grant colleges, the department has initiated, funded, and supervised a vast program of research, development, and demonstration projects. Today, the department works closely with state agricultural experiment stations, the Cooperative Extension Service, industry, and other agencies in a complex of projects related to rural affairs. Coordination of all the department's research and educational activities is the responsibility of the Science and Education Director, who reports directly to the Under Secretary. They include direct research (for example, at Beltsville, Maryland), research done in cooperation with the state experimental stations and

other agencies, the Federal Extension Service which applies research findings to day-to-day rural problems, and the largest library on agriculture in the country.

The federal-state-local agricultural research program comprises comprehensive research and development in agriculture and forestry -- ranging from basic research to direct application of R&D results to individual farms, families, and business firms involved with agriculture. The program is financed on a matching-fund basis, with the states matching the federal funds allotted and with counties also contributing to extension services. Currently government funds for agricultural R&D amount to about $450 million annually; industry provides an equal amount in addition. As a direct result of agricultural R&D, the productivity of American farmers has multiplied many times.

Health: A large part of the nation's biomedical research and training is concentrated in the National Institutes of Health. Federal funds for these activities grew significantly during the 1950s, as Congress recognized important new prospects for improving the nation's health through research (triggered in part by the discovery of the Salk vaccine and spectacular developments in the new sulfa, antibiotic, and other drugs). By 1970 the total budget of the National Institutes of Health (including ten separate research institutes and certain other responsibilities, notably health manpower) is expected to be $1.5 billion.

The National Institutes of Health is primarily concerned with research -- not development -- and with education in the health field. Nearly 90 percent of NIH-sponsored activities is "extramural," i.e., it is carried out through grants to universities, medical schools, hospitals, clinics, etc. The remaining 10 percent includes NIH's own extensive research activities at Bethesda, Maryland. Although the National Institutes of Health is part of the Public Health Service on the official organization chart, the head of NIH reports directly to the Secretary of Health, Education, and Welfare, through the Assistant Secretary for Health and Scientific Affairs.

NIH-sponsored research has made possible a better understanding of the underlying causes of cancer, heart disease, and other illnesses -- an understanding which brings closer the day when these diseases will be successfully cured and, ultimately, prevented. Development of a rubella vaccine, improved treatment of acute leukemia in children, and a successful cure of a rare cancer affecting young women (chorio-carcinoma) are but a few of the fruits of NIH research. Other developments, such as progress in the deciphering of the genetic code, have far-reaching implications for the entire field of medical and biological sciences.

Need for New Effort in American Education

Education has long needed a national research effort, commensurate with those in agriculture and health, focused on the improvement of learning and teaching. Now is the prime moment to bring all available resources to bear in strengthening educational research, development, and innovation, which for far too long have commanded insufficient funds and talent.

While many basic questions still remain unanswered or disputed, there are encouraging additions being made to man's understanding of the hows and whys of human learning in all its variations. One important reason is the gradual coming together of research specialists who once operated almost in isolation: new findings from the laboratory studies of human and animal learning, for example, are interacting with findings from actual classrooms.

Today America needs to examine the basic assumptions (too often unexamined) on which schools and colleges operate. If indeed schools are to be humane environments for learning and not mere institutional accumulations, if diplomas and degrees are to be more than mere passes to economic and social acceptance, America's vast decentralized educational "system" must undergo a revision that draws upon the best insights that can be cultivated: from scholars of diverse disciplines, teachers, philosophers, and artists, administrators, citizens generally, and from the ultimate consumer -- the student.

In recent years, the federal government has spent increasing amounts for education. Under the Elementary and Secondary Education Act of 1965, for example, about $4 billion has been allocated to upgrade education in deprived areas. But these funds were not invested to get to the roots of education's problems, nor to design a system with more adequate theoretical and technological foundations. The money has been used primarily to repair and extend the present system.

The Commission has concluded that the nation's investment in education must be increased and its thrust changed if America is to resolve its present basic educational and social problems. To be sure, public expenditures on education are nominally accepted as an "investment" in the nation's economic and social future. But the situation today requires that substantial funds for education be allotted for investment more strictly construed: as capital to create an improved system of teaching and learning which will produce more real individual and social achievement for each dollar spent than is done by the present system.

The Commission believes that the problems of teaching and learning could yield to an organized and systematic attack, and that the refinement and imaginative use of instructional technology could contribute signally to the success of that attack. Certainly the solution of education's problems is as critical for the nation's future well-being as is a cure for cancer, heart disease, or stroke, or the development of more efficient techniques for growing and harvesting wheat.

A New Emphasis: Development and Application

Fully as urgent as expanded, sharply focused research is the need to improve the essential follow-through known as development and application. The process of successful innovation entails several stages. First, there is specific development which produces from a new idea a particular program -- for teaching reading to children in the early grades, for instance. Second, there is a design-and-proving stage, to test the new program in the schools. Third, training and follow-through enable key people to run broader trials in the schools, and constantly feed back information on problems and discoveries which may modify the program. Finally, there is a transmission of the new program in usable form to interested schools throughout the nation.

There is, of course, seldom so orderly a process as this sequence suggests. The role of creation, of pure invention, is all-important in education as in any other science or art. And it would be stultifying if innovation had to wait on solid research results and development procedures. The ideal process that needs support and encouragement is circular: the bright idea, successfully improvised by a teacher, administrator, or student can spur research, as well as the other way around.

It is clear, moreover, that even the best programs of research, development, invention, and application, if they are to have practical, large-scale effects, require improved efforts in packaging, disseminating, and evaluating. Therefore, educational improvement could be furthered by concentrating funds and effort on disseminating outstanding theoretical and empirical findings in usable form. Increased funds could be applied, for example, to quicker and wider communication of important findings through television, radio, and other new media.

Further details with respect to the National Institutes of Education

1. The National Institutes of Education, through its various constituent institutes, should take over the activities of the Office of Education's present Bureau of Research, which include the ten Research and Development Centers and the fifteen Regional Educational Laboratories funded under Title IV of the Elementary and Secondary Education Act of 1965. It should also assume such other educational research, development, and application projects as clearly fall within its purview.*

The recommendation that a new agency absorb the present functions of the Bureau of Research implies no derogation of that hard-pressed organization which in its brief existence has made a marked contribution, quantitatively and qualitatively, to education. Federal support for educational research, however, is still wholly inadequate. The total for 1969 (all of it in the form of grants or contracts) amounts to no more than $125 million, and goes largely for applied research, very little for basic research or for development. Moreover, in the summer of 1969, the research program is in the midst of a cutback.

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*The National Institutes of Education should assume only the research responsibilities now under the Office of Education. Operating programs (see chart, page 72), which now make up the bulk of OE programs, should remain in the Office of Education.

2. The National Institutes of Education should also be expected to maintain close ties with relevant research and development being conducted in the many federal agencies outside the Department of Health, Education, and Welfare that operate education programs;* also with the American Educational Research Association and with practitioners in other relevant disciplines such as social scientists and engineers.

3. The National Institutes of Education could use the research models in agriculture and health as guides. In its disposition of research funds, for instance, the N.I.E. might well follow the lead of the National Institutes of Health in concentrating research in universities and other research-oriented institutions through grants. In other important matters, however, agricultural research and development might offer a more appropriate model; e.g., with respect to the close collaboration maintained with state and local agencies and the emphasis on development and application as well as basic research.

4. The National Institutes of Education proposed in this report may well be involved in research projects running three to

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* Among these other agencies are the Atomic Energy Commission, the National Aeronautics and Space Administration, the National Science Foundation, the Office of Economic Opportunity, the Department of Labor, and the armed forces. (The U. S. Office of Education budget in fact, has never amounted to more than one-half of the total federal funds devoted to"education and manpower.") Another relevant private-public enterprise of importance is the program recently established by the Office of Education with the National Academy of Sciences and the National Academy of Education to finance basic research in education.

five years or more in length. Annual funding in the ordinary way would limit the effectiveness of such projects. The new organization, therefore, should explore with the Bureau of the Budget the possibility of obtaining authority to use "no-year appropriations" for research programs, or forward-funding arrangements (100 percent committed for the first year, two-thirds for the second year, and one-third for the third year) similar to those developed by a number of government agencies including the National Science Foundation, the Atomic Energy Commission, the Environmental Science Services Administration, the National Aeronautics and Space Administration, and the Department of Defense.

RECOMMENDATION #2

WE RECOMMEND:

A National Institute of Instructional Technology (N.I.I.T.) should be established as a constituent of the proposed National Institutes of Education. The purpose of the N.I.I.T. should be to improve American education at all levels through the use of instructional technology. The focus of the Institute's activities should be on research, development, and application in equipment, instructional materials, and systems, and also in training personnel.

The proposed National Institute of Instructional Technology should strengthen and promote the most promising of the Research and Development Centers and Regional Educational Laboratories (now operating under Title IV of the Elementary and Secondary Education Act of 1965) which are conducting programs involving instructional technology, and should establish such other regional centers as it deems necessary.

The National Institute of Instructional Technology should increase significantly the quality and quantity of the research, development, dissemination, and action programs needed to fulfill instructional technology's potential for advancing learning and teaching.

Like its fellow institutes, the National Institute of Instructional Technology could be a new locus of talent, energy, expertise, and imagination for American education, providing leadership and initiative for efforts from many sources. It should bring together scholars from many disciplines and experts from the various media representing divergent viewpoints, including talented people who have hitherto dedicated themselves primarily to their own professional fields and organizations and to their own communities and institutions.

The influence and impact of the National Institute of Instructional Technology, like the National Institutes of Education as a whole, would derive principally from the stature and performance of the people mobilized, and from the initiative taken in advancing educational improvement. By its use of funds, its development and dissemination of new ideas, and its direction of selected pilot programs to achieve innovation in schools and colleges, the National Institute of Instructional Technology should generate a new, more coherent thrust toward continuing improvement throughout American education. Its work and that of the other institutes should serve as guides for the many programs carried out through the Office of Education -- a cooperative way of translating researched, developed, and tested methods and ideas into effective action programs.

In line with the general policies for the proposed National Institutes of Education outlined in Recommendation #1, the National Institute of Instructional Technology should instigate and sustain programs of research, development, and application relating to its responsibility. It should encourage and support regional, state, and local activities, encourage initiative and invention, and provide a diversity of approaches to the critical problems of instruction in the schools and colleges. Of first importance would be the National Institute of Instructional Technology's leadership in finding effective ways to improve and expand the production of educational materials -- perhaps through the creation of new production centers that would draw on both public and private resources.*

The Commission cannot emphasize too strongly the importance of "a diversity of approaches." The National Institutes of Education and its constituent institutes should constantly foster alternative schemes, in much the same way as systems analysis encourages alternative solutions to an objective that has been established. The problems of education will not be solved by any one approach. The very diversity of human beings and cultural patterns demand diverse approaches. In the past, education has tended to overlook this diversity and has been inclined to proceed on the assumption that everyone should be able to learn in much the same way. We propose, therefore, a decentralized pattern for the programs sponsored and coordinated by the National Institute of Instructional Technology, and we envisage regional clusters of institutions -- universities, school systems, state departments of education, production centers --

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*An example of combined efforts is the Children's Television Workshop, which is scheduled to go on the air in the fall of 1969.

working together on projects of common interest and of national significance.

The Commission strongly endorses the concept and objectives of the Research and Development Centers and Regional Educational Laboratories.* In line with the institutional pattern outlined above, certain centers and laboratories would clearly fall within the scope of the National Institute of Instructional Technology. All the laboratories make some application of technology, with considerable variation in the degree of sophistication of the various programs. A few of the Research and Development Centers, such as Pittsburgh, Johns Hopkins, and Stanford, stress technology. The center at the University of Pittsburgh has been outstanding in combining basic research with regular programs in the local schools. This center and others are in effect providing models and prototypes for further development by the Regional Educational Laboratories.

But underfinancing has been a major handicap in the evolution of these fledgling enterprises, both centers and laboratories, and has slowed down their contribution to education. In comparison with the amount of federal support for major research and development installations in other fields, the federal support for educational research, development, and application must be described as token. The Jet Propulsion Laboratory, sponsored by the National Aeronautics and Space Administration, and the Lawrence Radiation Laboratory, sponsored by the Atomic Energy Commission, each receive 20 percent or more of the total federal obligation for university-administered research and development; no Research and Development Center in education has ever received much more than 1 percent of the total.

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* The Research and Development Centers and Regional Educational Laboratories operate under grants from the U. S. Office of Education's Bureau of Research. The R&D Centers, all located within universities, were originally organized to provide basic research, development, and dissemination. Each center aims to bring interdisciplinary talent and resources to focus on a broad problem of particular significance to education and then to design programs to meet it. The Regional Educational Laboratories, on the other hand, were established as an effort to bridge the gap between educational research and practice -- in effect, the "application" part of R. D. & A. They were expected to work much more closely with local schools than the Research and Development Centers -- to select promising research and development activities, demonstrate their effectiveness, adapt materials and techniques for practical use in the schools, and disseminate their findings.

The Commission proposes that those laboratories and centers making the most promising advances in the use of instructional technology be funded by the proposed National Institute of Instructional Technology, that the institute be empowered to establish new centers as needed, and that these laboratories and centers be adequately financed, well-directed, competently staffed, and then encouraged to operate with genuine independence. The new centers should, for the most part, conduct multipurpose research, development, and application.* Exceptions would be R. D. & A. in high-cost experimentation which would necessarily be more highly specialized.

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* The centers could also provide facilities (and possibly funds) for teachers and others with talent and ideas to experiment with the production of instructional materials employing a variety of media.

The National Institute of Instructional Technology should provide a meeting ground for the many organizations concerned with media, such as the Corporation for Public Broadcasting, state agencies including public broadcasting authorities, and the diverse groups with some interest in the technology field.* Although increasing numbers of classrooms make some use of instructional films, television programs, tapes, records, etc., the exponents and practitioners of the various instructional media operate without sufficient contact, coordination, and cross-fertilization. "Media apartheid," as one expert calls it, has helped to subordinate nonprint media to the hegemony of the printed book. Moreover, professional associations and the organization of schools and colleges (for example, the separation of the library, the audio-visual center, the television stations, and the computer facility from one another -- even though all of them should be collaborating on instructional programing) have encouraged this separation. Instructional technology needs a central agency with national stature which could function as a base for those outstanding practitioners from each field who want to work with others across media boundaries to apply their knowledge, experience, and insight to the solution of pressing educational problems.

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* For example, the National Education Association, the American Federation of Teachers, NEA's Department of Audiovisual Instruction, the Joint Council on Educational Telecommunications, the National Association of Educational Broadcasters, the American Association of School Librarians, the Association of College and Research Libraries, the National Audio-Visual Association, the Educational Media Council, the American Council on Education, and the American Library Association.

An essential counterpart to the efforts to use technology for more effective instruction is research, development, and application in the techniques for storing and retrieving information in all media. There is need to develop better tools for the analysis of library and information requirements and improved ways of measuring the value of existing systems and services. The Commission, in considering this problem, finds itself in agreement with recent recommendations of the National Advisory Commission on Libraries.* A principal recommendation was for a Federal Institute of Library and Information Science to conduct basic and applied research aimed at using technology to improve library services. The National Institute of Instructional Technology would be a logical location for these functions.

Another highly important feature of the research, development, and application efforts recommended here should be worldwide cooperation in the full utilization of instructional technology. If technology's potential can be thoroughly explored, analyzed, and confirmed in the United States, the results could be adapted to the educational needs of other countries -- with particular impact on the developing nations. Also of importance are the lessons the United States could learn from other countries, a number of which are experimenting widely with instructional technology.* International collaboration could reduce duplication of research, development, and application and speed the advancement of education in the United States and throughout the world.

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* In a report to the President of the United States, entitled Library Services for the Nation's Needs, July 1968.

Major functions and programs envisaged for the National Institute of Instructional Technology are spelled out in further detail in Recommendations #3 through #6, which, together with the details in this recommendation, reflect the following priorities:

- Fundamental research in technology as a total system, both in helping to find answers about the learning and teaching processes and in putting research results into practical application.
- Development of a system by which practicing educators in schools and colleges throughout the country would have ready access to the widest possible range of materials and resources for instruction, in every medium and subject.
- Improvement of methods of evaluating the relative effectiveness of various educational resources (human and nonhuman) and their combinations in the learning patterns of individual students.

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* To cite one example, Japan has been a world leader in the use of instructional television, and should have much to offer in the way of advice, direction, and example.

- Exploration of means for developing high-quality educational materials comparable in sophistication to the machines or equipment now available or about to be available.

- Development and application of improved methods of preparing teachers, administrators, and many different kinds of specialists in the best uses of instructional technology, including access to reliable comparative economic and performance data on hardware, programs, and technological systems.

- Collaboration with industry in exploring ways to develop hardware especially suited to instructional needs.

- Concentration of all the foregoing efforts on helping achieve, through technology, solutions to the nation's most acute educational problems, such as:

  Improving learning in disadvantaged schools, urban and rural; for preschoolers; and for the handicapped.

  Developing the most fruitful approaches to making instruction truly individual.

  Revitalizing liberal arts and professional education and relating higher education more significantly to personal and social experience.

Developing practical ways for community colleges to meet the diverse and increasing demands being made upon them.

RECOMMENDATION #3

WE RECOMMEND:

The proposed National Institute of Instructional Technology should take the lead in efforts to identify, organize, and prepare for distribution the high-quality instructional materials, in all media, capable of improving education.

For this purpose, the National Institute of Instructional Technology should consider establishing a center or "library" of educational resources. Among this agency's responsibilities would be: identifying those areas in which there is a shortage of educational software, and making public these findings; assisting school and college libraries to transform themselves into comprehensive learning centers; and stimulating interconnections (among specialized libraries, data banks, schools, and colleges) for comprehensive and efficient access to instructional materials and educational management data.

The improvement of teaching and learning through the use of instructional technology has been impeded less through the lack of equipment than through the lack of high-quality instructional materials designed for use with the equipment. The Commission has learned from people in virtually every field -- teachers and educators, as well as experienced producers in film, television, and the computer -- that the insufficiency of excellent materials or programs has been a critical and persistent factor in preventing the development of a genuinely effective instructional technology.

Yet there is a considerable amount of potentially useful material in many media which could be made available to education. The chief problem is that there is no effective system by which materials can be identified, organized, and made conveniently available to educators.* Such a system would provide a new wealth of information for the improvement of learning and teaching.

The suggested center or library of educational resources would not be a "library" in the usual sense of a repository of books, magazines, and other printed materials. The most advanced libraries today have begun to expand the usual meaning of "library" by gradually developing into complex information storage and retrieval institutions designed to be much more than a collection of books. The center which the National Institute of Instructional Technology might establish would perform a set of functions quite distinct from collecting books and other instructional materials.

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* This gap is in large part the result of the rudimentary state of research and development in the techniques for handling information transmittal in all media. As noted in Recommendation #2, the National Institute of Instructional Technology should give high priority to a program designed to meet this need.

It would not itself store the vast amount of relevant resources. Rather, the center would supervise and coordinate a wide range of functions that would include finding, sifting, adapting if necessary, and cataloging materials suitable for educational use. It would provide educators with information about materials in each subject field, for each level of instruction, and in every instructional mode and media. A kindergarten teacher seeking manipulative materials to develop eye-hand coordination, a third-grade teaching team seeking films and audiotapes about the American Indian, a middle-school curriculum supervisor preparing a unit of programed instruction in mathematics, a high school principal looking into televised courses in Far Eastern culture and history, a college professor desiring to use language-laboratory tapes for teaching introductory Swahili, a graduate university seminar studying the sociology of Latin America, a corporation developing a literacy program for hard-core unemployed -- all would be guided by the center to materials relating to their instructional tasks.

Because it would cover all media, all subjects, all levels of education, the center's program would provide a needed synthesis and augmentation of the various national organizations already involved in this field, such as the National Audiovisual Center, the National Instructional Television Center, the Great Plains National Instructional Library, the National Center for Audio Tapes, the National Educational Television Libraries, and the National Medical Audiovisual Center, as well as pertinent collections at the Library of Congress.

This agency should also assist school and college libraries to identify, receive, store, and make available new instructional materials. This would entail their transforming themselves into comprehensive learning centers. Fortunately, many libraries are already far advanced in this reorientation. Further progress should facilitate the development of more flexible, individualized instruction at every level of education.

A central educational resource center would provide educators everywhere with the fruits of "search/find" operations, and might encourage the establishment of working arrangements for exchange of material within educational institutions, libraries, and clearinghouses. These arrangements should be coordinated on a regional basis, with the aim of eventually becoming computer-based.

Exchange of materials between libraries is an old practice. The computer has made it possible to completely revolutionize this process and has made the planning of networks central to the creation of any new national library facilities. In the last decade a number of computer-based storage and retrieval systems, centers for gathering and dispersing technical information in various fields, and cooperative interconnections of learning institutes have taken shape. But there has been no comprehensive attempt to unite these systems, libraries, and data banks to meet the demand for both instructional materials and research information on the process and management of education.* The National Institute of Instructional Technology should take the initiative in exploring possible arrangements for organizing such networks for instructional use.

In the immediate to short-term future, a network could feasibly develop the capability to provide bibliographic information on educational materials and research, indexed conveniently for the inquirer. However, the long-range future presents the possibility, indeed probability, of full-text access to books via computer, as well as instant transmittal of nonprint media. The realization of this potential, however, requires the solution of several very complex problems, among them the development of principles and practices relating to standardization, compatibility, and copyright.

Systematic coverage and analysis of what exists in all instructional media, subjects, and grade levels would yield an invaluable by-product -- the identification of gaps in the supply of instructional materials. The National Institute of Instructional Technology could then keep the whole private sector (including producers and distributors of hardware and software for every level and area of education) informed and aware of the schools' needs and priorities. (This would be done in collaboration with the council suggested in Recommendation #6).

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* Educators are faced with the problem of accessibility with regard to information about the process and management of education. These data must be readily available if they are to attempt to effectively design conditions of learning along "systems" lines. The ERIC system is attempting to collect and make available such information. It is limited by lack of funds as well as by the difficult problem of reproduction of copyrighted materials. The Commission believes that the ERIC system should be strengthened, and that it should be tied into any network plans established by the National Institute of Instructional Technology.

RECOMMENDATION #4

WE RECOMMEND:

The National Institute of Instructional Technology should support demonstration projects designed to improve instruction through the wise exploitation of technology. These projects should be concentrated initially on a few carefully selected communities or individual schools -- including urban ghettos, impoverished rural areas, and communities with populations that are predominantly black, Mexican-American, Puerto Rican, or Indian.

The school system of the District of Columbia might be invited to mount the first of such model demonstrations.

The National Institute of Instructional Technology should invite selected schools and communities to participate in demonstration projects and should be responsible for coordinating the use of public and private funds for this purpose. However substantial the amount of money involved, the total number of projects should be relatively small, in order to sustain a high-quality, concentrated effort in each one with a saturation of available resources.

Projects should be designed to achieve maximum visibility and impact, and should initially be keyed to meet severe educational problems. The Commission believes, therefore, that the first and largest demonstration might well be in Washington, D. C. The rationale is clear. While education in the nation's capital should be a model of excellence, this city's schools suffer perhaps more than most city school systems from lack of funds, inadequate staff and facilities, preponderance of impoverished minority-group students, flight of the middle classes to the suburbs.

While these demonstration projects would specifically try out technology in its various ramifications, each project should be based on a total educational concept. The choice of schools and communities should take account of prospects for eventual self-support. Strong commitment of school and community leaders therefore would be a prerequisite. In some cases the actual administrative and instructional patterns would have to be altered to accommodate the demonstration. The experiment should include not only public schools and community colleges, but also programs for persons now outside the formal educational system -- such as preschool children and unemployed, under-employed, and retired adults.

These comprehensive demonstration projects should operate under the continuing guidance of the National Institute of Instructional Technology and its regional affiliates. Purchase of hardware, physical changes to buildings, and preparation of new curricular material should all be closely interwoven, and the impact of these developments might well stimulate even more fundamental changes.

As for demonstrations designed to benefit out-of-school groups, we suggest that private foundations, industry, and educational institutions be urged to supplement federal, state, and local government funding, and in addition, to provide professional and technical aid. Funding and active collaboration could come from a variety of sources, depending on the projects. For instance:

(a) A community agency could develop an educational package in cooperation with a local vocational school, a local television station, local employers, and a nearby univeristy or community college. Citizens could be trained for specific jobs through special counseling and multimedia presentations, including television and programed texts. The "diploma" would be a job.

(b) A day-care center could augment its usual activities by installing individual learning carrels equipped with imaginative programed materials for preschool children. Here the children could pursue beginning reading, number concepts, and entertaining introductions to other new worlds -- nature, the arts, or certain sciences.

Neighborhood housewives, college students, and retired people could, with minimal training, oversee the enterprise without the need for constant attendance of professional teachers.

(c) A variety of distribution media (telephone, television, radio) could reach adult audiences at home. Projects for homemakers and workers could be mounted in subjects as diverse as business arithmetic, health care, and computer programing. Imaginative programs to acquaint the public with the accomplishments and promise of technology in education could prove of great value.

(d) The National Institute of Instructional Technology could help design a Job Corps center that would use instructional technology in depth, taking full advantage of the armed services' experience in job training, and trying out various combinations and sequences to meet each student's individual background, capacities, and interests.

Technology could facilitate distribution, presentation, and feedback. It could also encourage cooperation among several agencies -- a critical aspect of any successful project. The National Institute of Instructional Technology's challenge would be to bring schools, universities, industries, social agencies, and individual citizens together in active participation and involvement in the advancement of education.

RECOMMENDATION #5

WE RECOMMEND:

The National Institute of Instructional Technology should take the initiative in encouraging the development of programs to improve the capacity of educators to make more effective use of instructional technology and programs to train specialists. To this end, the N.I.I.T. should support new programs, based on increased research and development:

(1) To provide administrators and department heads with the knowledge necessary for managing technology effectively;

(2) To educate school and college teachers in the most effective uses of instructional technology and in the differentiated staffing patterns technology properly entails;

(3) To increase the number of qualified specialists such as producers, programers, and technicians that schools and colleges need if they are to exploit technology fully.

Besides initiating new programs, the National Institute of Instructional Technology should also strengthen and expand the best existing programs for training and employing educational manpower in the wise application of instructional technology.

"Teaching is the only major occupation of man," Peter Drucker wrote recently, "for which we have not yet developed tools that make an average person capable of competence and performance. But education will be changed, because it is headed straight into a major economic crisis. It is not that we cannot afford the high costs of education; we cannot afford its low productivity. We must get results from the tremendous investment we are making."

In order to increase their productivity, the nation's schools and colleges require a larger supply of diversified, highly qualified manpower. They need administrative leaders -- college and university presidents, deans of instruction, department heads, school superintendents, and principals as well as state and federal officials, school board members, and college trustees -- who fully understand the prospects for improving education through technology.

In addition, the teacher or professor, from kindergarten through graduate, professional, and continuing education, should understand how new media can be employed to make instruction more effective and more responsive to the individual student.

Moreover, supporting specialists and technicians of many types are needed if a mature technology of instruction is to flourish. The qualifications required in these three categories-- administrators, teachers, specialists -- are distinctive.

Administrators

In the decades ahead, administrators will be required to make many complex decisions which they are not now being prepared to make wisely. The problems faced by the educational manager are changing rapidly. Tomorrow's educational manager will have to be able to handle a variety of responsibilities, many of them outside the walls of the school or college or state education department. He will need a background in education certainly; but he will also need training and experience in the behavioral and social sciences, in finance and management, and in the development of human resources. The thrust of this recommendation is not toward reviving a "cult of efficiency" for education. Schools and colleges are already overcommitted to rigid formulas for efficiency which prescribe class size, block scheduling, departmentalization, credits, etc. Technology must free, not fetter.

Of great importance, then, is concentrated research, development, and application on the special knowledge school and college managers can make effective use of: what tools are required, what methods (of economic analysis, staff recruitment and deployment, community and staff relations) are most efficacious, how the essential data can be acquired, how purposes and accomplishments can be best evaluated, how educational institutions can be staffed for maximum exploitation of television, recordings, projectors of various kinds, programed instruction, and other kinds of instructional technology -- ultimately, how schools and colleges can redesign themselves to educate America's young people most effectively.

The paucity of data even as to the functions of administrative manpower in education was recently emphasized by the Office of Education's first report on the state of the education professions, required under the new Educational Professions Development Act. In the matter of instructional technology, the educational manager should understand how to find out what he needs to know about the potentialities and problems of instructional technology, and how to recruit and use the talents of people who can serve in this field effectively. Obviously the school superintendent or university president himself cannot and need not be a sophisticated judge, purchaser, or user of hardware and software. But he should be able to depend on a staff qualified to advise him or to act in these matters. He and his associates should know also which technological applications have proved their worth, and which promising developments are imminent, whether in "older" media such as film or in new ones like the computer.

In instructional technology, as in other crucial aspects of educational management, the immediate need is for programs that will combine down-to-earth experience with formal training in appropriate disciplines. Various graduate schools of education are concerning themselves with this task, but their efforts must be multiplied and reinforced to make any real dent on the day-to-day management of the nation's educational institutions. Schools of business and public administration, architecture, and engineering should also participate. To this end, intensive efforts to establish management-training programs should be mounted by federal agencies in partnership with universities, school systems, state departments of education, and industry.

These management-training programs should command sufficient money to produce a marked improvement in the use of technology and in the way schools are managed. They could take many forms, including summer institutes, continuing seminars, and longer-term university internships and fellowships -- all informed by constant feedback from the field.

One educational observer has suggested the creation of a "staff college for higher education executives," adding that top university officials "need both mirrors and windows -- so that they can look inward as well as outward." The National Academy for School Executives' advanced seminars, which have devoted particular attention to instructional technology, point the way toward such a program for school administrators.* Clearly, the most promising of these programs now in operation or projected should be supported by the National Institute of Instructional Technology.

Sophisticated, practical pre-service management training is also essential. The immediate concentration of funds and ingenuity should, however, be on in-service training, since most administrators, especially in the lower schools, come up through teaching.

Teachers

There is evidence today that school teachers, a traditionally conservative group, are beginning to see the value of using technology for educational purposes. Lois V. Edinger, professor of education at the University of North Carolina, wrote to the Commission:

> The vast majority of the members of the teaching profession have accepted the fact (or in some cases simply become resigned to it) that education must leave the era of "hand labor" and turn to machines to help increase their productivity. That we must turn to the using of power tools in education to allow teachers to become more effective is a fact accepted by the teaching profession today, albeit with varying degrees of pleasure and readiness.

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* The National Academy for School Executives is an adjunct of the American Association of School Administrators.

Dr. Edinger's words are of special significance since she is a recent past president of the National Education Association and undoubtedly expresses the view of many schoolteachers. It appears to be true, however, that most college teachers continue to resist the "inroads" of technology.

A central benefit (as well as prerequisite) of the comprehensive application of technology to education will be a more systematic approach to instruction. The role of the teacher needs to be more explicitly defined than ever before. The teacher, therefore, should understand the far-reaching implications of technology in order to function at his individual best as the central element of the total system. The base for this understanding should be laid in the teacher's own education, not just in demonstrations and lectures on technology, but through the actual use of technology in his courses.

Unfortunately, few teacher-training institutions give even passing attention to the role which technology could play in improving the quality of education. Only infrequently does the education of prospective teachers make use of such media of instruction as television, tape recorders, or computers. And the teacher who does have exceptional training in technology will be frustrated if the school or college where he begins his teaching career regards technology as a mere accessory.

Once on the job, moreover, teachers are apt to find that daily pressures leave little time to "figure out behavioral objectives" or to experiment with the best tools for meeting those objectives. There is little incentive for the teacher to innovate. And should the teacher decide that he indeed does want to use some new medium, he is faced with the problem of availability and maintenance. At worst, the elementary-school teacher (probably female, and probably "allergic" to machinery) is required, for instance, to manage a 16mm film projector which was designed by a male for nonschool purposes and which needs mechanical expertise for operation and maintenance. Margaret Mead said on this point:

> Teachers will use machines for instruction when they're as easy to use and as foolproof as the washing machine.

In-service training for school teachers, while it may provide the new teacher's first brush with technology at work, is often as unsatisfactory as pre-service training. Both are centered far more on the mechanical "how" of technology rather than on the "why."

The situation was summarized for the Commission by A. W. VanderMeer, dean of Pennsylvania State University's Graduate School of Education, as follows:

> The pre-service preparation of the teacher must be followed by a continuing program of in-service education. It matters little whether these in-service activities are conducted by the universities, by school districts, by professional societies, or by a combination of these. The essential thing is that they be conducted and conducted well. Not only must education follow current graduates into the field, but also the existing instructional personnel presently manning the schools must not be neglected.
>
> Of particular importance is the use of technology itself in bringing in-service education to the field. Modern extension work is pioneering the use of video- and audio-tapes, conference telephone hook-ups, and other exploitations of instructional technology. Such advanced applications of technology are, unfortunately, in the minority.

Nevertheless, more and better training in itself will not satisfy the diversity of demands on education and educators. A true technology of instruction almost demands a re-ordering of the instructional staff, to take account of individual talents and capabilities among teachers and also of the range of different jobs teachers are asked to do. One answer to this complex problem is differentiated staffing, with which a few schools have begun to experiment.

This new concept was set forth as follows in the Office of Education's first report on the state of the education professions:

> Differentiated staffing is based on carefully prepared definitions of the jobs educators perform, and goes beyond traditional staff allocations according to subject matter and grade level. For example, a differentiated staffing plan developed by Temple City, California, has created a logical hierarchy that includes not only teaching but instructional management, curriculum construction, and the application of research to the improvement of all systems. . . .
>
> The aims of differentiated staffing can be realized through a number of different methods. Additional positions such as part-time tutors and aides on one hand and educational specialists on the other could be appended to either end of the hierarchy. Organization need not be hierarchical, but can be based on teams of peers. Whatever the method, however, the aim is to permit a variety of people to contribute. The housewife-teacher, for instance, can make her services available on a schedule satisfactory to her, and without hindering the professional advancement of the career-minded teacher. Indeed, the career-minded teacher is stimulated by such a system, which provides not only a hierarchy of more challenging and more significant roles but also allows for promotion and advancement as a teacher instead of solely as an administrator or supervisor.

Even short of fully differentiated staffing, schools and colleges require specialists of many kinds. As the next two sections suggest, the full realization of technology's potential for education calls for an array of staff members who are not teachers. The key figure may ultimately be a versatile and highly trained specialist called an "instructional designer."

Specialists

Throughout American schools the need for talented people who are not specifically trained as teachers is becoming more and more acute. Specialists are needed to develop technology as an integral part of the instructional process. Aides of all kinds are needed to assist teachers in making the best use of technological media and of their own professional capacities. Perhaps most important, scholars in many disciplines and creative people in every area should be contributing their special gifts to the instructional process. "As the field of education assumes new tasks and broader responsibilities," Harold Howe II has written, "there will be a growing need for people with competencies in many areas, from poetry to biochemistry, from plumbing to philosophy, people who might be persuaded to offer their expertise on a full- or part-time basis to the purposes of education."

Technology can achieve its fullest potential in schools and colleges only with technical and paraprofessional support -- "media coordinators" serving as advisors on the use of instructional technology, experts on the production and procurement of instructional materials, plus specialists in many different disciplines working with teachers in research and development.

The lack of specialists to facilitate its use in the schools and colleges could well be the Achilles' heel of instructional technology. The urgency for designing machines for easy use in instruction is equaled only by the urgency of having someone available to repair them if they break down. A language laboratory is of little use if it is out of operation for several weeks because chewing gum and bobby pins clog its vital parts. An investment in proper operation and maintenance of equipment is good economy.

Nonprofessional assistants are also needed, especially in the elementary schools. Such tasks as running simple machines, playground duty, and routine clerical duties can be carried out by teacher aides (who may be housewives willing to work part time), thus releasing regular teachers to more adequately employ their professional talents in advancing the quality of instruction.

Planning for the development of instructional technology should include the recruitment of such nonprofessionals. As Professor Robert H. Anderson of the Harvard Graduate School of Education told the Commission: "The emerging concept of auxiliary personnel in education has already created an impressive literature, which has recently begun to focus on the important topic of training auxiliary personnel. Not only can technology play an important role in the training of such workers, but it seems increasingly necessary for these people to be familiar with technology as an aspect of their work."

Whether a staff advisor in instructional technology is necessary might be disputed by those who have been discouraged by experiences with the typical audiovisual department of a school or college. It is the exceptional audiovisual department that is integrated into the fabric of the institution -- with qualified audiovisual consultants sitting in on courses, sharing in the teaching methods and environment, and then contributing to improvements through technology and otherwise.

Qualified specialists in the production of instructional materials are scarce. Producers, graphic artists, audio technicians, and programers are but a few of the professionals needed to develop maximum effectiveness in instruction. Lack of expert advice in the production of instructional television programs, for instance, has often produced mediocre results. All too little is known about how to present instructional material over television most effectively. Creative use of the medium has been barely attempted. There is no doubt that the "talking face" has been overdone in instructional television. But even this technique has its usefulness and could be made more effective. Outstanding lecturers who fail to come across over television could improve their performance on the screen with help from skilled professionals.

The scarcity of good programers for the teaching machine undoubtedly tempered the initial enthusiasm for this device, and may be seriously handicapping current efforts in the various modes of programed instruction. Training and financial support for production and programing specialists should have top priority.

Instructional Designers

The need for someone to work with teachers in their planning strategy as well as someone to help students in using libraries, data banks, or computers to their best advantage, is apparent. Institutions could combine forces and share the services of one instructional technology advisor, who could also conduct research and development in "instructional design."

Research and development in education are dependent upon the interaction of specialists from many different fields. The meager success of research efforts to date can be attributed in part to the dearth of well-qualified research specialists. If research and development efforts are to be relevant and fruitful, they must enlist the participation of behavioral scientists, subject-matter scholars, engineers, educators, and others. The central figure in this "mix" may well be an instructional designer, whose role Robert Glaser has described as follows:

> It is highly probable that a unique occupational specialty called instructional design will emerge in view of the current level of heightened interaction among educators, behavioral scientists, educational publishers, electronics and computer industries, and R&D organizations in educational technology. This specialty will involve a person or group of persons concerned with the production of educational procedures, materials, and systems.

Instructional designers need to pick off appropriate research and development activities from behavioral science knowledge, and behavioral scientists need to pay attention to the fundamental problems generated from attempts at technology. From this interplay there will emerge a body of pedagogical principles or a technology of instruction that will be fundamental to the task of instructional design.

As educational systems incorporate more of the advances of science and technology into their design, the specialty of instructional design will grow, and there will probably be many different sub-specialties; for example, applied research and development, operational materials design, computer systems, teacher practices, language and linguistics, preschool learning, etc.

Instructional designers in applied research, development, and production capacities will be in increasing demand in the near future. Indeed, at the present time, such persons are rare and eagerly sought.

RECOMMENDATION #6

WE RECOMMEND:

The National Institute of Instructional Technology should take the lead in bringing businessmen and educators together in a close working relationship to advance the productivity of education through technology.

To this end, the National Institute of Instructional Technology should consult with other interested organizations and develop an appropriate mechanism. A possible course of action, for example, could be the establishment of a National Council of Education and Industry that would focus on how technology can best meet the needs of individual students, teachers, and administrators. A small high-level council of this nature, with representatives from key branches of education and the education industry, could help speed appropriate advances in the design, development, and application of technology to instruction.

The free marketplace for materials and equipment has generated great benefits in education, as in other sectors of American society. However, there is increasing realization today that in the major fields of social service, such as medicine, the operation of the free market must be supplemented by some mechanism to make sure that innovation and diversity are encouraged, quality maintained and enhanced, and the most urgent social goals achieved. Education lags behind other fields in providing help to practitioners in making wise choices among competing products, and in spelling out its precise needs.

Until a decade ago, the "education industry" was virtually synonymous with textbook publishing. Then, as substantial new federal funds became available for the purchase of newer kinds of equipment and materials, publishers began, through acquisition or expansion, to branch out into various areas of instructional technology. But the central fact remains that the school and college budget for equipment and materials is still relatively small.

What is called for is a closer scrutiny of the process by which machines and programs have been developed and marketed. Educators have played little or no part in developing new products. They have not been informed on a regular basis of recent developments, nor has industry devised an adequate process for obtaining their advice and counsel. When new equipment comes on the market, many educators are in the dark about the advantages and disadvantages of the various options offered and are at the mercy of sales propaganda and rhetoric. Thus many purchases made by schools and colleges have been inappropriate and premature. On the other hand, educators themselves have not always demonstrated a realistic understanding of technology's potential for instruction, nor of industry's problems in meeting educational needs.

In general, these conditions obtain today:

- Many technological devices offered to educators are designed mainly for uses other than education; this drawback applies particularly to the computer, which needs distinctive features to be wholly adaptable to education (for example, larger memory capacity, greater simplicity, and better display capabilities).

- Equipment prices are geared to what the commercial market can bear; there has been no concerted attempt to bring them down to levels acceptable to education and the taxpayers who support it. Most schools and colleges simply cannot afford needed equipment.

- Many institutions lack equipment they need (e.g., television, computers). Some are overstocked with equipment (e.g., movie projectors, overhead projectors) which is largely unused or seriously underused; in many cases the equipment on hand is fast becoming obsolete and constitutes a serious barrier to the acquisition of new improved devices.

- Instructional material to stoke promising devices is inadequate; new hardware comes to the market years before enough worthwhile programs are ready to meet school and college needs.

- The quality of most of the software that *has* been developed is relatively poor. The problem is insufficient money and talent for the concentrated effort required to produce good materials.

- Material is often limited to use on a machine of one particular make. For example, one company's videotape recorder will not take another company's tapes. Until a solution can be found to the problem of incompatibility of equipment and programs, the effectiveness of instructional technology will be correspondingly retarded.

- As indicated earlier in this report, many technological devices are too complex for teachers to use readily and often. When breakdowns occur, repairmen are not immediately available. Maintenance is a serious problem; lack of funds and manpower often renders equipment unusable.

- Field testing of new devices before they come on the market is minimal. As a result, educators receive little validated evidence on which to base their purchasing decisions.

In short, educators at present who do not suffer from lack of equipment often suffer from having too much obsolete or unused equipment, or the wrong kind of equipment, or equipment with insufficient good software, or incompatible equipment, or equipment too complex for proper maintenance.

A close new working relationship between industry and education should be possible if each group actively demonstrates its willingness to cooperate, to understand the other's problems, and to make necessary compromises.

For this essential cooperation of education and industry to bear fruit, certain changes in attitude and approach are required.

For instance, industry must be willing:

- To forego immediate profits, to concentrate on development of equipment and materials for the long run, and to abandon the belief that because a product sells well, it is educationally sound. (Since the market for educational materials is still relatively small, sustained development by industry may well require federal pump priming.)

- To develop intensively a limited number of products which have proven effective for instructional purposes; and to work toward solving the incompatibility problem.

- To work with teachers, administrators, and students in the development and redevelopment of materials and equipment.

Educators, for their part, must be willing:

- To define instructional objectives clearly enough so that materials and equipment can be produced to meet them, and then to use items produced that meet these specifications.

- To help test new devices and to persevere with innovations until they can be properly evaluated.

- To acquire the necessary understanding of technological innovations and develop sound methods for measuring their capabilities.

The Commission believes that a mechanism should be created to initiate and cultivate such a cooperative effort. We therefore recommend that the National Institute of Instructional Technology take the lead in establishing an effective group to carry out these objectives. One mechanism would be a small, strong, high-level national council, with representatives from key branches of education and the education industry. In setting up an appropriate and forceful group of this order, the N.I.I.T. should work with organizations such as the Corporation for Public

Broadcasting, the Educational Media Council, the American Textbook Publishers Institute, the Education Commission of the States, the Joint Council on Educational Telecommunications, the American Library Association, state departments of education, the National Association of Educational Broadcasters, and the National Audio-Visual Association. Through constant feedback from the field (teachers, administrators, salesmen, managers), a council of this sort could keep in touch with new and persistent problems and with the most promising lines of product development.

An organization representing education and industry should develop and institute improvements in the design, development, maintenance, and utilization of instructional technology. The functions of such a group would include:

(1) The establishment of standards for instructional equipment.

(2) Concerted action to meet the specific needs of schools and colleges.

(3) The development of practical methods to make equipment and materials compatible.

(4) The establishment of a mechanism -- perhaps a clearinghouse -- to provide education's managers with comparative operating and economic data on technological instruments and systems designed for administrative as well as instructional purposes.

(5) Initiating or improving laws and regulations affecting instructional technology (e.g., copyright laws, satellite controls, reduced rates for long-distance educational communication).

(6) Active cooperation with the National Institute of Instructional Technology in devising ways of directing federal and private funds toward the production of high-quality instructional materials.

(7) Exploration of new methods for providing school districts with funds for instructional technology, including the possibility of leasing or renting equipment, or the purchase of equipment on a "pay-as-you-go" basis.

(8) Active cooperation with educational institutions, under National Institute of Instructional Technology leadership, in establishing practical programs to train and retrain the managers of education.

Chapter VI

NOTE ON APPROPRIATIONS REQUIRED

For more than a year the Commission on Instructional Technology has examined technology as it affects or could affect instruction. Our focus throughout the study was to determine how technology could contribute to the improvement of learning in schools and colleges. Our recommendations deal with the major problems to be solved if instructional technology is to fulfill the potential the Commission believes it has for education.

The questions that naturally follow are: How much money is needed? How soon is it needed? What sources should supply it?

For guidance the Commission looked at the research and development carried on in industry, agriculture, and health. Extensive national programs have been in operation for many years in these fields, conducted and financed in partnership with local government, business, universities, health and agricultural agencies, and other organizations. The programs have grown substantially during the past decade:

> In industry, about 4 percent of net sales is spent on basic research, applied research, and development of research findings by manufacturers performing some research and development activities (that is, approximately $18 billion a year).

> In health, an amount equivalent to nearly 5 percent of the nation's total expenditures for health services is spent on research (that is, about $2½ billion a year).
>
> In agriculture, an amount equivalent to almost 6 percent of the total net income from farming is spent on research, development, and application by government agencies, universities, industry, and local agricultural organizations (that is, about $900 million a year).

In education, however, research expenditures amount to no more than one-fourth of 1 percent of the nation's expenditures for schools, colleges, universities, and other educational enterprises -- that is, a total of no more than $125 million a year. A few years ago the ratio was only one-tenth of 1 percent.

By 1980, the Commission believes, educational research, development, and application should reach the proportions already achieved in industry, agriculture, and health -- in other words 4 to 6 percent of total expenditures for education. It is essential to take appropriate steps now toward meeting this greatly increased outlay.

Obviously a program of these dimensions must be phased in gradually. Even if all the money which education needs for basic and applied research, development, and the application of important findings to instruction were available immediately, the nation could not at once supply the manpower of appropriate background, training, or experience to put the money to use effectively and wisely. The United States has just begun to apply to education the research, development, and application techniques that have long since proved their worth in other sectors of society. Within the past few years, for example, new Research and Development Centers and Regional Educational Laboratories have made advances in the theory and practice of instruction. It will be necessary to strengthen and expand such advances, building upon them to achieve a more fully effective educational system.

In educational research and development we must learn by doing. As in the space program, there is no other way. The formulation and refinement of new basic theories are essential. But basic research encompasses only part of the total research-and-development effort required. Sustained development and the application of findings to thousands of practical school and college problems are also essential. Moreover, research findings must come to the schools and colleges packaged for practical use.

The Commission has concluded that only the federal government can undertake the major responsibility for the expenditures for basic and applied research, development, and application required in the years immediately ahead. Furthermore, we believe that the minimum initial financing required to carry out the recommendations of this report is approximately $565 million. Of this about $150 million would be required to launch the National Institutes of Education and the National Institute of Instructional Technology. The remaining $415 million would be required for the first full year of operation, including approximately $250 million for the research, development, and application activities of the institutes, $25 million for the center or "library" of educational resources, $100 million for demonstration projects, and $40 million for the training of personnel. The aggregate amount suggested would equal no more than 1 percent of the projected total expenditures for American education in fiscal 1972.

This proposed budget, it should be noted, includes the present research activities of the U. S. Office of Education; it is, however, an addition to other authorizations for education programs by government and private agencies. It assumes that existing programs as authorized by Congress and other appropriating bodies would be fully funded, including specifically those provided by the Public Broadcasting Act of 1967 for the construction of educational television and radio stations and for the continued operation of the Corporation for Public Broadcasting.

Appendix A

THE STATUS OF INSTRUCTIONAL TECHNOLOGY TODAY

The impact of technology on instruction has been small compared with the magnitude of the educational system in the United States as a whole. For example, some 50 million pupils attend class in elementary and secondary schools every day for an average of five hours each. This amounts in the aggregate to a total of 250 million pupil class hours every day, or a grand total of 1,250,000,000 pupil class hours every week from early September to mid-June. A reasonable guess is that in any week not more than 5 percent of the time involves media of instruction other than the teacher, the book, the blackboard, and pictures, charts, and maps hung on the wall. For higher education, the estimates are of the same order. There are many observers who say that a closer estimate would be 1 percent. These low estimates reflect the well-attested fact that even schools that are equipped with technological media may use them little if at all.

> Research indicates that a large part of the existing hardware now in our nation's schools is not being used, or used properly. This has come about partly because the national audio-visual thrust has been toward the acquisition of equipment and materials with very little concern toward the development of programs that increase the proficiency of their utilization.
>
> Ira Polley
> Superintendent of Public Instruction
> Michigan Department of Education

The Commission had many well-informed specialists prepare reports on the present status of the various technological media used for instructional purposes.* In addition, the staff assembled information on the use of technology from individual institutions, from manufacturers and distributors, and from state and federal government agencies. Briefly, the situation with respect to the major media and their applications is as follows:

1. Audiovisual media**

Today most schools and colleges have some audiovisual equipment. This ranges from two or three record-players in the library and one broken 16mm projector in the auditorium, to an active audiovisual facility with an extensive film library, many well-maintained projectors, and a production unit for slides and transparencies.

The growth of some audiovisual departments in recent years has been dramatic. In 1955, for example, the University of Colorado's film library owned one projector and 1,200 films and had a staff of three people. By 1969, the film library had grown into a regional center, with 2,800 pieces of equipment, between 8,000 and 10,000 films, a computerized film-booking system, and a full-time staff of 45.

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* A diagnosis of the causes of the current low status of instructional technology will be found in the next appendix.

** For convenience, this account follows the common if unsatisfactory usage that reserves the term "audiovisual media" for the oldest of the newer media such as 16mm and 8mm film and projectors, slides and film strips, telephones, audio tape-recorders, records and record-players, and overhead projectors. These are the "audiovisual aids" that most parents and some teachers think of when the subject of instructional technology is raised.

The increase in equipment for the nation as a whole has been less dramatic than in this example, but it has been constant. Some estimates on individual types of equipment appear in the next two pages. The table shows the present stock of selected items; the graph shows the trend in expenditures for audiovisual equipment and materials.*

The statistics do not by themselves reveal how often the various media are used, nor for what purpose. According to informed opinion, audiovisual media are generally employed intermittently and then only to enrich and supplement the familiar patterns of classroom instruction. For the most part, they merely augment the conventional teaching strategy which has hardly changed for more than a century. "They are used primarily to give data which the reasonably effective teacher could give anyway and/or at least to furnish a momentary diversion from business as usual," Wilbur Rippy, curriculum resources specialist at Bank Street College of Education, wrote to the Commission.

> Except for the promise of the application of programed instructional principles to conventional audiovisual production, few innovative breakthroughs have been made to involve the learner actively in learning from audiovisual presentations. Active participation by the learner has been shown to increase learning significantly, yet our audiovisual materials show no signs of recognizing this fact.
>
> William H. Allen, Adjunct
> Professor of Education and
> Cinema, University of
> Southern California

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* Including, in this case, radio and television.

ESTIMATED NUMBER OF ITEMS OF AUDIOVISUAL MATERIALS AND EQUIPMENT OWNED BY U.S. PUBLIC SCHOOLS, JULY 1969

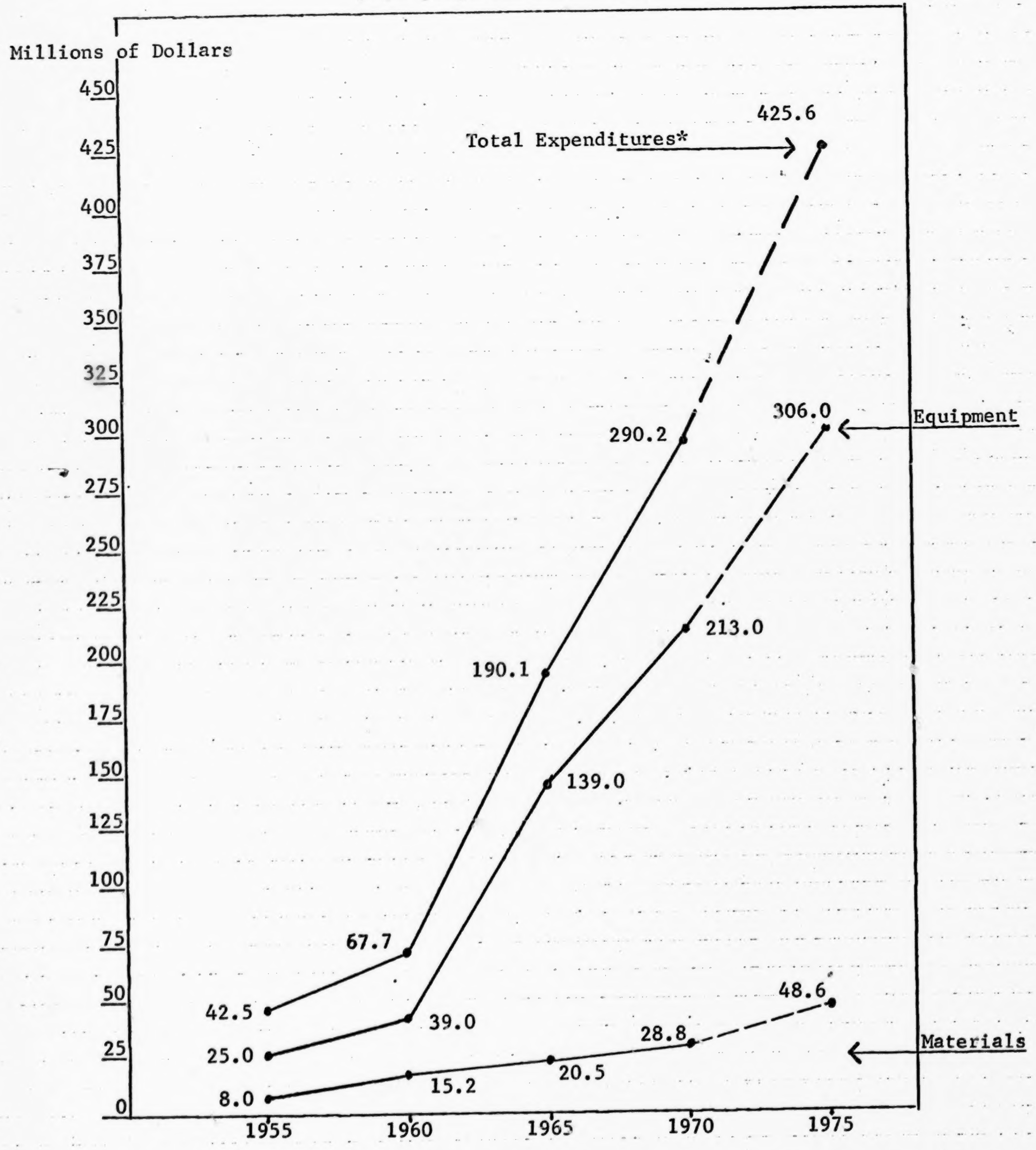
Selected Equipment	
Screens	919,000
Record Players	698,000
Earphones	576,000
Overhead projectors	453,500
Slide and filmstrip projectors	426,000
Tape recorders	320,000
16mm projectors	251,000
Learning carrels	171,000
Slide or filmstrip viewers	163,000
Reading devices	98,600
Opaque projectors	91,600
Transparency makers	71,200
8mm projectors	58,600
35mm slide cameras	27,200
Rear screen projectors	22,200
16mm cameras	14,100
Drymount presses	11,750
8mm cameras	7,200
Microprojectors	6,180

Selected Materials	
Filmstrips	21,700,000
Still and flat pictures	12,400,000
Disc recordings	7,200,000
Overhead transparencies	5,230,000
Maps and globes	4,200,000
2" x 2" slides	2,400,000
Tape recordings	2,020,000
16mm films	1,315,000
Reading programs	336,000
8mm films	104,000

Source: Loran C. Twyford, New York State Education Department, 1969

Note: The total number of public schools operating in 1969 was estimated at 92,500.

EXPENDITURES FOR AUDIOVISUAL EQUIPMENT AND MATERIALS
BY ELEMENTARY AND SECONDARY SCHOOLS
1955 TO 1970
(with projections to 1975)



*Note: Total expenditures include equipment and materials plus other items such as maintenance and general overhead. Totals are probably low but trend is indicative of recent developments. Data do not include computers or programed textbooks, but do include radio and television.

Source: U. S. Office of Education

Overall, it is reasonable to say that despite increasing demands for greater individualization of instruction and for more emphasis on learning rather than teaching, audiovisual technology is seldom used to bring about educational change. It is still predominantly a subsidiary and supplementary element of group-paced, group-prescribed instruction where one teacher faces 20 to 30 students in 45-minute units of time in classrooms comprising around 1,000 square feet of enclosed space.

> A miniature self-instructional system using 8mm cartridge films has been developed at San Jose State College and was initially applied in teaching audiovisual techniques. This method has proven that for many "how-to-do-it" and informational topics college students can use media to learn successfully by themselves. The 8mm methods developed for audiovisual production and equipment operation techniques have been extended to teaching the operation of keypunch machines, industrial arts woodshop and craft skills, use of advanced chemistry laboratory equipment, and occupational therapy practices.
>
> Richard B. Lewis, former
> director, Audiovisual
> Services
> San Jose State College

In recent years, some schools and colleges have demonstrated the ability of the audiovisual media to liberate teacher and student from the educational lock-step. Audiovisual storerooms that once served only the classroom teacher have been transformed into rich and responsive learning centers for both teachers and students. According to Colonel Howard B. Hitchens, Jr., the traditional audiovisual media have been integrated into the instructional processes at all of the military academies.

Harvard's Project Physics has used audiovisual media to fuse the reality of physics with the requirements of individual students and teachers. Overhead transparencies, 8mm film loops, 16mm films, and laboratory equipment are combined with the live teacher, standard printed materials, and programed texts in a course which provides maximum flexibility. In the words of Gerald Holton, director of the project:

> It should be possible for a given student to become fully fascinated with the straightforward quantitative content of the discussion of the law of universal gravitation and its consequences in physics; he should be able to pursue this by further reading (as in the Reader excerpts on gravity experiments) and/or by doing a Cavendish experiment, or at least getting the data from film. And for this particular student this involvement might be at the expense of the study of the historical background of Newton's work, which in his case might not be of primary interest. But his neighbor, in the same class, should to some degree be allowed (and furnished equally good tools) to have somewhat the reverse experience, as long as he does not slight the minimum physics content which is set out for him in the course.

In a small number of schools, photography and film-making are encouraging an active, participatory type of education. There is evidence that film-making, linked in with film-watching, "speaks" (particularly to the deprived child) in a way that normal book-oriented instruction does not.

> Doing, however, is even more fun than viewing. And doing with the new media is where the sex appeal is at. Kids with still and motion picture cameras, kids with audio and video recorders are having more fun than other kids.
>
> John M. Culkin, S.J.
> Director, Center for Communications
> Fordham University

2. Television and Radio

Today instructional television fills less than 3 percent of total classroom hours in the elementary and secondary schools of the country's 16 largest cities. In Boston, home of one of the most successful educational television stations, WGBH, the city's 148 elementary schools own only 150 television receivers, with another 50 spread among its 36 junior and senior high schools. Ohio State University's radio station, which helped pioneer the use of radio in schools in the 1930s, was transmitting two programs a week to schools by 1967-68.

> One is tempted to say that television courses today are in the McGuffey Reader stage. For nearly half a century educational films have compressed large amounts of pictorial information into ten-minute reels with a narrator "telling it." They break the class routine, then it's over and done without much relation to course or lesson plan.
>
> Robert B. Hudson
> Senior Vice President
> National Educational Television

Elementary schools are the major audience for open-circuit instructional television (as differentiated from closed-circuit television and 2500 megahertz). The all-purpose teacher in the self-contained classroom has been willing to get some specialized help, in subjects like music, art, and science, from educational stations. Secondary schools make significantly less use of instructional broadcasting, because of scheduling difficulties and also because secondary schools of any size have such specialists as art and music teachers. Radio and television appear spasmodically in adult (or "continuing") education.

> With few exceptions, television is usually simply imposed on long-established curricula and administrative systems. As such, television becomes an addendum, an adjunct, and ultimately an insignificant line item in the school budget. Solid attempts to use the medium effectively for instructional purposes are few.
>
> Frederick Breitenfeld, Jr.
> Executive Director
> Maryland Center for Public
> Broadcasting

According to a 1967 survey, closed-circuit television was being used at 717 out of 15,581 educational institutions identified as likely television users. Five years earlier, 403 such institutions were found to be using closed-circuit television. One major function of closed-circuit television in colleges is to distribute the normal classroom lecture to overflow students in the crowded first-year and second-year courses. At Michigan State University, for example -- one of the largest users of closed-circuit television in higher education -- 13.3 percent of student credit hours in the freshman and sophomore classes are earned via television.

Generally, television and radio, like older audiovisual materials and devices, are being used to "enrich" but not change traditional education. In most school television the screen time is filled with the face of the studio teacher, who is almost certain not to be one of the great minds working on the frontiers of the subject matter presented. Despite the growth of videotape libraries and regional networks, the dream of shared resources and the widespread exposure to a corps of real master teachers has not been fulfilled. Moreover, the large number of local production units have led to a dissipation of talent and dollars. Underused studios are constant reminders of television's status in American education at the present time.

There have been demonstrations, however, of television and radio used imaginatively and effectively. Some colleges of medicine and dentistry, for example, are realizing one constructive potential of television: image magnification and image transportation. Psychiatrists also find television a useful research tool. A North Texas network is using television with telephone talkback to take postgraduate education from the campus to graduate engineers who have gone out into industry. Low-cost videotape recorders are giving some student teachers the opportunity of watching themselves teach. In a few schools and colleges, television brings visual primary source materials to students -- live meetings of the Security Council of the United Nations, for example, or taped presidential press conferences of the past.

In American Samoa, for a number of years, television has been part of -- and an enabling agent for -- a comprehensive reform of elementary and secondary education, along systems lines. This comprehensive reform included a major overhaul of curriculum, a move away from rote memorization in the classroom, the production of high quality integrated materials in print and nonprint, a complete administrative and logistical reorganization, the construction of new schools, a school lunch program, and systematic in-service training and supervision for the classroom teachers. Television was designed as the core of instruction, part of an overall instructional strategy worked out by teams of specialists.* Samoa contrasts strongly with the highly fragmented organization of schools on the mainland where it is customary for one committee to decide on textbooks, another on television lessons, a third on school architecture, with minimum cooperation and maximum autonomy.

> The scope and limits of educational radio today are clearly indicated by the range of operating budgets available to the medium. Almost 50 percent of the stations operate on budgets of less than $20,000 a year. As might be expected, the educational radio medium is beset with manpower problems. These arise from the obvious budgetary limitations, the lack of salary and career incentives, and the powerful attraction to the young of television, which has overshadowed the aural medium for almost two decades. Moreover, there do not appear to be many managers who function full-time in station operation. Most often the school-connected stations combine station management with other functions, such as teaching, departmental administration, TV management, and so forth.
>
> Management, staffing, and budget limitations are in the final analysis directly related to school administration attitudes toward the medium. With few exceptions, institutions of higher education do not accord radio the same degree of concern they do other interests, and thus fail to develop it fully as an educational resource.
>
> The Hidden Medium: Educational Radio
> Prepared for National Educational Radio
> by Herman W. Land Associates, 1967

Since 1955, Albany Medical College, through WAMC, has been pioneering the use of two-way radio for the continuing education of doctors.

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* The report from the new Governor of Samoa, in July 1969, was that the change in the management contract for the Samoan educational program would not affect the achievements described above.

There are now more than a half dozen of these networks in operation across the country. The Wisconsin State Radio Network uses part of its frequency allocation to provide specialized programing for nurses and a French program for high-school students. through a system called multiplexing which permits normal programing to continue undisturbed.

A typical WAMC two-way radio conference includes an announcer, a studio moderator, the network audience (located at 70 hospitals in a 100,000 square mile area), a moderator at each hospital, and faculty drawn from one or more of 28 medical colleges. The audience in the community hospital is able to follow the presentation with the aid of mimeographed outlines and sets of 35mm slides previously mailed to each hospital.

At the completion of the "lecture" the community hospital moderator gathers written questions and comments from his associates and alerts the studio moderator, using an electronic alerting system. Replies to the questions are made directly by the faculty. Unanswered questions are mailed to Albany for transmission to the faculty who then mail replies directly to the questioner.

Multiplexing, 2,500 megaherz television (Instructional Television Fixed Service), community-antenna television arrangements, low-cost recorders, satellites, and Electronic Video Recording -- all have great potential for education. To date, however, their use and effectiveness have been limited -- both in quantity and quality.

> The current sum total of all applications of television to instruction has not made any lasting, important, or basic impact on any part of American education.
>
> * * *
>
> Detailed arguments supporting the learning effectiveness of televised materials are not needed in this paper. Suffice it to say that there is a veritable mountain of research findings to indicate that people can learn any number of skills from television-facilitated instructional systems.
>
> * * *
>
> Television provides the potential of allowing mass-scale educational programs to be carried forward with uniform, basic opportunities and standards for all participants. It can be the facilitating means of mass education in a genuinely democratic age.
>
> The fact that the medium has been seldom used to carry out this important function in no way denies the truth of these assertions.
>
> The National Association of
> Educational Broadcasters

3. Programed Instruction

During the second half of the 1950s, programed instruction, embodied in the teaching machine, enjoyed a short period of enthusiasm which quickly waned. In the words of Susan Meyer Markle, a pioneer and authority in the field, "The impact of programed instruction on the educational system has been minimal, quantitatively and qualitatively."

One important reason for the decline in the use of programed instruction was that the teaching machine came onto the market long in advance of the appropriate software. Also, according to a 1965 survey of recent programs produced for schools, 40 percent provided no evidence of pretesting, despite the fact that programed instruction claimed to be the first real application of scientific principles to learning. By 1967, a sampling survey showed that the situation had actually deteriorated -- 70 percent of the programs had not been prevalidated.

> The computer can be an exciting educational tool without requiring tremendous financial investment. Students of every age use it and have a wonderful time with it. For instance, they can try out arithmetic problems on the computer, and it will give answers. Used this way, the computer creates a responsive learning environment and is thus a very powerful system. And the price is not high, because this kind of software is not expensive. If we limit its instructional use to the programing of full courses, however, the fate of the computer could be similar to that of programed instruction: a good idea that was more or less ruined by poor and premature exploitation.
>
> J. C. R. Licklider, Professor of
> Psychology and Electrical
> Engineering
> Massachusetts Institute of
> Technology

Today the sale of programed instruction materials to education constitutes only a small fraction of the total dollar sales volume for textbooks. However, programed instruction has had considerably more impact on training programs in the armed services and in industry.

The technology of programed instruction challenges traditional teaching methods. The teaching machine and the programed text which has now largely replaced it present the subject or skill to be learned in many small steps, with regular opportunities for the student to make responses and to know immediately if he is correct. The learner moves at his own pace, instead of at the pace of the group, and some programed materials permit him to branch off on different tracks.

> When a study at Michigan State University revealed inefficient use of laboratory time in Advanced Mammalian Physiology, the Instructional Media Center developed a preparatory course in basic laboratory techniques. Audiotapes and slides -- supported by programed texts and 8mm single concept films -- are incorporated in a course through which each student can proceed at his own pace prior to entering the action lab. The most notable result of the new system was to reduce the time needed in the regular lab from five hours to four. The hour saved was used for the discussion of experimental results, which before tended to be crowded out by the time taken just to set the experiments up. Student interest and appreciation for the course were greatly improved.

But too often, instead of changing educational procedures in the direction of greater individualization, programed instruction has become an addendum to conventional educational offerings. Recently, proponents of programed instruction have redirected the thrust of the movement. According to Douglas Porter of Harvard: "Some educators think of programed instruction as another 'medium' of instruction, like television or tape. It is not. Programed instruction is a process for the specification, design, perfection, and validation of instruction, a process which is applicable to all media. The full implication of programed instruction can be appreciated only when this point is understood."

Programed instruction thus becomes synonymous with instructional technology in its "systems approach" meaning. "The concept of programed instruction," according to Robert Glaser of the University of Pittsburgh, "should de-emphasize the present orientation around educational 'media,' e.g., films, television, and language laboratories, and place emphasis upon the process of instruction in which the special advantages of various media can be assessed."

> When considered in relation to their proposed intent to truly individualize instruction, the quantity of programed materials available to the schools is still miniscule. Given the wide range of objectives which school systems might wish to reach and the wide variance in student characteristics, we are a long way from the "well-stocked shelves" that would enable teachers to diagnose and prescribe, as promised by the technology. Small doses of self-paced instruction prove disruptive within the normal lockstep progression, but individualized instruction without appropriate materials also has disadvantages.
>
> Susan Meyer Markle, Head
> Programed Instruction
> Office of Instructional Resources
> University of Illinois

4. Language Laboratories

Language laboratories began to appear at some of the larger universities in the early 1950s. After 1958, when the passage of the National Defense Education Act provided matching funds for the purchase of such equipment, thousands of schools and colleges in every part of the country began to install it.

However, there was a serious lack of software. The assumption was that the classroom teacher could write the script in her spare time and record the tapes that would be needed. "The results were sometimes disastrous," Elton Hocking, Professor of Modern Language Education, Purdue University, told the Commission. "Lacking the facilities and techniques for successful recording, the high-school teacher produced a soundtrack that was amateurish at best. More important, the content was often merely copied from the textbook, which was never intended for such use."

After a few years, despite the establishment of NDEA Institutes for the training of teachers in the use of the new equipment, the early enthusiasm for language laboratories declined. Interest was reawakened only after the arrival on the market of commercially produced integrated materials which included films and filmstrips along with tapes and textbooks. Although these packages promised to be effective, they were expensive, and many school boards therefore purchased just the book and tape combinations, foregoing the films and filmstrips. Moreover, the teachers, now released from the heavy task of recording tapes, found themselves almost as busy cataloging, bookkeeping, ordering supplies, and arranging for repairs required as the result of breakdowns or vandalism.

Today, after nearly a dozen years of intensive experience, it is clear that language laboratories have realized only a fraction of their educational potential. Moreover, their success is likely to depend to a large extent on comprehensive reform in the method of teaching languages. The traditional grammar-based method is likely to be changed only over a considerable period of time.

> "The language lab as a teaching machine" was a perfectly sound concept of the programer, but to the public and to many schoolmen it meant that the machine, as such, could teach. Not a few teachers actually feared for their jobs. Today it is common knowledge that the machine can only repeat the program fed into it, and that a good program requires almost infinite care and time to prepare, try out, and revise repeatedly.
>
> Elton Hocking
> Professor of Modern Language
> Education
> Purdue University

5. The Computer

The computer has three main uses in education: it is a research tool; it is a management tool; and it is a teaching-learning machine.

As a research and study tool, especially in higher education, computers have been in use since the mid-1950s. Today faculty and students in many disciplines are increasingly exploiting the computer's power of computation, data processing, problem solving, and simulation. In this usage the computer's function is not to "teach," as it is in computer-assisted instruction (CAI), but to provide the student with new ways of exploring and manipulating the subject matter he is studying and the data at his disposal.

One problem, however, is that computers -- both the machines themselves and the skilled manpower they require -- are expensive to acquire or lease and to operate. Their use for research and study purposes is concentrated, therefore, in a relatively small number of institutions. The President's Science Advisory Committee, in its 1967 report on Computers in Higher Education, noted:

> . . . at some fortunate and forward-looking colleges and universities the educational use of computers is widespread and effective. But this does not apply to the majority, where computing facilities are often absent or inadequate . . . .

Recently the computer has been playing an increasing role in the development of information-retrieval systems for research purposes. Information-retrieval services for educational needs -- to date, highly specialized -- are beginning to appear. Some examples of research-directed information retrieval are:

1. The National Library of Medicine's Medical Literature Analysis and Retrieval System (MEDLARS), based in Bethesda, Maryland, with various regional stations. MEDLARS indexes the contents of approximately 2,300 biomedical journals published throughout the world and stores bibliographic details on magnetic tape. Doctors and research workers can retrieve bibliographic information both by subscription to bibliographic publications and by computerized demand searches.

2. Chemical Abstracts Service, based in Columbus, Ohio, has been collating and publishing information about chemistry and chemical engineering since 1907. Now becoming increasingly computerized, it has a full-time staff of about a thousand and an annual budget of over $12 million.

3. A consortium of institutions of higher education, with headquarters at the University of Michigan, has developed a computerized system for political-research data.

Educators have already begun to consider the broader applications of computerized information retrieval for schools and colleges. At the higher education level, the Interuniversity Communications Council (EDUCOM) has among its concerns, yet unrealized, information retrieval for research, instructional, and administrative purposes.

Computerized information retrieval could also upgrade the few operations already serving the needs of educational researchers. The Educational Research Information Center (ERIC), set up by the United States Office of Education and comprising 19 regional centers, is the outstanding example. "ERIC on Line," at the Stanford clearinghouse which concentrates on instructional technology, is an experimental advanced computerized retrieval system that permits searching more than 12,000 documents in the ERIC system and viewing selected abstracts on a cathode-ray screen. ERIC looks forward to further development of computerized services.

The extensive use of computers for management purposes in higher education, particularly in larger institutions, is not surprising, considering bulging enrollments and increasing amounts of data to be processed. Administrative uses of the computer vary from the fairly straightforward keeping of scholastic records to the more complex problems of forecasting future building and staff requirements via simulation techniques.

In elementary and secondary schools, the computer's use in administration is less widespread, but growing. New England Education Data Systems (NEEDS), based in Waltham, Massachusetts, provides computer services to help member schools with file creation and maintenance, schedule construction, attendance accounting, test scoring and analysis, and student marks. NEEDS has found that the introduction of computers for such administrative purposes can open the door to instructional uses of the computer.

The computer may prove to be essential for schools wishing to introduce flexible scheduling, with classes of different sizes meeting for different lengths of time. A truly individualized system of instruction, which tracks the student through his own curriculum at his own pace using an appropriate range of different media, will generate -- and require -- masses of data which must be manipulated if the system is to work.

A few programs are exploring the use of computers to relieve the increasingly heavy burden placed on guidance counselors. The computer can advise a student on course selections as well as on future educational and career decisions. David V. Tiedeman of Harvard University carefully notes that the computer, in itself, can "only help individuals understand their career development. To this end machines are instruments, not masters, in career development."

Computer-assisted instruction, although it dominates the headlines, has to date had much less impact on education, both quantitatively and qualitatively, than the other two uses of computers. One of the nation's most publicized CAI systems operates in New York City. Here there are 200 terminals in 16 schools operating at an annual cost of about $1 million a year. At the most, 6,000 children -- out of one million children in daily attendance in the city's schools -- are getting an average of 10 minutes of CAI in one subject per day.

Despite the claims that the computer is a highly flexible teaching-learning machine, the predominant application thus far of CAI in schools and colleges is for drill and practice. Don D. Bushnell of the Brooks Foundation told the Commission that most such systems do little more than dispense "instruction in a fixed, preprogramed sequence of graded instructional material. . . designed to perpetuate the standard classroom procedures." The more creative modes of computer-assisted instruction -- tutorial, inquiry, and simulation -- are used much less frequently.

Lawrence M. Stolurow, director of the Harvard Computer-Aided Instruction Laboratory, observed in a paper prepared for the Committee for Economic Development: "The available software, both computer and educational, is in a very primitive state of development." The lack of an empirically validated theory of learning and teaching has been a major obstacle to the development of computer-assisted instruction. But CAI does hold out the promise of helping to make learning a truly individualized process. In this connection Stolurow warned the Commission not to confuse the present reality of CAI with its potential: "Projections based upon today's systems would have the same degree of fidelity as projections based upon the Wright brothers' first plane would have had for predicting the design of the supersonic transport."

Today, there are fewer than 1,000 computer-assisted instruction terminals serving fewer than 20,000 public-school students. When we subtract from these totals terminals and students involved in limited experimental and demonstration projects, we find that the parameters of operational computer-assisted instruction shrink to less than 500 terminals and 16,000 students.

* * *

Until now mathematics drill and practice at the elementary school level accounts for a large percentage of what has been defined as operational computer-assisted instruction.

* * *

There has been practically no systematic assessment and evaluation of the effects of the use of computer-assisted instruction where it has been employed. In some cases, CAI installations have not had access, either internally or externally, to personnel qualified to conduct valid evaluations; in other instances, the individuals responsible for CAI have been preoccupied with the myriad problems accompanying the introduction of a highly innovative program and, therefore, have postponed evaluation.

* * *

There is an urgent need to deeply involve specialists in learning research from the university community in the systematic assessment and evaluation of present and future computer-assisted instruction applications in the public schools. Federal and state educational funding authorities must assign a higher priority to this need than they have in the past.

* * *

The relatively few studies which have been conducted on CAI effectiveness do create a basis for optimism about the eventual contributions of the medium.

Lawrence Parkus
Radio Corporation of America

6. Dial Access

There are an estimated 120 dial-access information-retrieval systems in schools, colleges, and universities across the country, enabling the teacher in the classroom and the individual student in the study carrel to retrieve, by dialing a number, limited amounts of instructional material. (The material is stored centrally and distributed via audio and/or audio-video channels.) For example, the system at Ohio State University, which like many others developed out of a language laboratory, has approximately 400 different reception points at various campus locations.

A dial-access system at Oklahoma Christian College, opened in 1966, has 136 audio channels and one reception point for each of the thousand-plus students on campus. It has enabled substantial revisions of teaching methodology to take place. A major problem in education -- the disparity in background knowledge which students bring to courses -- is being tackled at Oklahoma Christian with special tapes to which any student can listen whenever he wants.

At some institutions, however, the effectiveness of dial-access has been slight. Hardware was developed without appropriate software, teachers were not sufficiently consulted, curricula were not revised to use the new media, and the dial-access equipment, often costing well over a hundred thousand dollars, has been left to gather dust.

7. Games and Simulation

Games and simulation, which can be enacted via a variety of media, have been used quite extensively by the armed services to teach military strategy and to train servicemen in the handling of highly complex electronic equipment. Simulation techniques are also proving popular in business, particularly for management training. In medical education, Hilliard Jason, Director of Medical Research at Michigan State University, told the Commission: "Instructional needs are of such complexity that simulation is likely to become the most important new educational development of the decade."

> The Board of Cooperative Educational Services in Yorktown, New York, has developed a game using a computer which permits the student to experience directly the basic principles of a primitive agrarian economy. An IBM 1050/7090 computer system simulates selected elements of the economic functioning of a Sumerian city-state around 3500 B.C. The student sitting at the typewriter terminal is the King, and the computer asks him on the basis of economic reports to decide how to use resources, while trying to keep the population stable and well fed.

Games and simulation are beginning to enter a small number of schools and colleges. A relatively uncomplicated application is driver education. More complicated are games such as those designed by the Educational Development Center in Newton, Massachusetts, for use by elementary and secondary school students in social studies. Empire, for example, enables children to gain an understanding of mid-18th century trading patterns by letting them play the roles of New England merchants, Southern planters, and admiralty customs men. The student seeks information, uses it actively, makes decisions, and then sees almost immediately the results of his decisions.

Appendix B

THE CAUSES OF TECHNOLOGY'S LACK OF IMPACT ON AMERICAN EDUCATION

There is hardly a school system or university that does not have one or more film projectors, slide projectors, record players, television sets, or other technological devices and materials. But the actual use of such media for instruction plays a very small part in the nation's total educational effort, and the systematic harnessing of technology to improve learning has been attempted only rarely.

Why has progress been so slow in fulfilling technology's recognized potential for education? What has impeded technology's impact on instruction?

There are many causes. Though most have been touched on in the recommendations and in the text of this report, it seemed useful to summarize them here.

The causes of instructional technology's present low status are so intertwined that it is difficult to separate them. Moreover, the Commission's study has revealed that certain conditions -- perhaps the most basic and telling causes of all -- are not peculiar to technology per se but pervade all American education. The first and most far reaching of these is lack of practical understanding about the process of human learning. Despite recent progress in educational research and development, educators still have few reliable, validated guidelines for choosing one instructional medium over another.

> The degree of ignorance about the process of education is far greater than I had thought. Research results are more meager or more contradictory and progress toward the development of viable theories of learning and instruction is far slower.
>
> Charles E. Silberman, Director
> Carnegie Study of the Education
> of Educators

On a more prosaic level, education suffers from insufficient money. Taxpayer resistance, outmoded sources of support, and rising demands for extended schooling have created major problems for education in general. The hard fact is that only a small fraction of school or university budgets is ever available for any form of instructional materials. The implications for instructional technology and other innovations are obvious. Most educational dollars are earmarked for staff salaries, and for new construction and maintenance.

Both inadequate knowledge of the learning process and lack of funds contribute to a third major barrier to needed educational reform. This is the very structure of today's formal education, a pattern of grades, courses, credits, departmentalization -- four years of higher education added to twelve years of elementary and secondary education -- which affords scant leeway for substantive, effective change in schools and colleges.

> Until we stop our futile efforts at minor adaptations of our obsolete egg-crate schools and build a new organizational and administrative structure, we have small prospect for success in gaining the full potential of recent advances in science and technology to dramatically improve learning in our schools and colleges.
>
> T. H. Bell
> Superintendent of Public
> Instruction, State of Utah

Thoughtful critics of education, within and without the establishment, are becoming convinced that only by radical rearrangement of the prevailing patterns of schooling can education be sharply improved. Some of the chief obstacles to fulfilling the potential of instructional technology reflect, according to these critics, organic defects in the educational system itself.

> There is no system to reward the innovator. A system does not exist which gives support (i.e., promotion, salary increase) to those interested in improving instruction. The organization and the institutionalization of education itself have formed the greatest barrier to the use of instructional technology. The research on instructional technology has consistently occurred within the system -- affected and controlled by the systemization already in existence. This system controls what we may experiment upon, how we may experiment, and how we are to treat the results.
>
> Richard E. Spencer
> Professor of Educational Psychology
> University of Illinois

Innovations patched on the conventional structure produce indifferent results. No matter how good a programed text is, for instance, it will find only marginal use in a group-paced school. Broadcast television programs, even with repeats, seldom fit in with standard academic schedules, especially in secondary and higher education. Innovations like programed instruction and television, it would appear, can effectively improve instruction only as part of an integrated, systematic reconstruction of the curriculum.

> A curriculum is a thing in balance that cannot be developed first for content, then for teaching method, then for visual aids, then for some other particular feature.
>
> Jerome S. Bruner
> Professor of Clinical Psychology
> Harvard University

Within this overall context constraining change, there are a number of more specific reasons for instructional technology's limited progress to date:

1. Indifference or antipathy toward using technology in education

Many administrators of school districts, colleges of education, universities, or state education departments regard technology, Professor Elton Hocking of Purdue University told the Commission, "as a kind of profanation of the classroom." The term "teaching machine," coined by early programed-instruction enthusiasts, epitomized the dehumanizing, depersonalizing influence of technology feared by many critics.

> Teachers exhibit a "bi-stable" attitude with respect to the use of technology:
>
> If they haven't used it, or if what they've used has been an irrelevant part of their busy schedules, they're sure they don't have time to use it.
>
> If, on the other hand, they have used it, and it has been a coherent part of a full set of learning aids, they say they don't have time not to use it.
>
> Jerrold R. Zacharias
> Professor of Physics
> Massachusetts Institute
> of Technology

2. Poor programs

Many educators believe that:

> The majority of television lessons, instructional films, programed texts, computer programs for instruction are of poor quality.
>
> Television is often little more than the distribution of a dull lecture.
>
> Many programed texts are uninteresting, uninspired, and just plain tedious.
>
> Instructional films are unsophisticated and unprofessional in comparison with offerings of the local movie theater or television stations.

Poor software is itself the manifestation of many contributing difficulties: lack of money, lack of trained and imaginative writers, directors, and programers; and resistance of educators to materials that are foreign to current classroom practice.

> Much of "the industry" is still too much outside the thought stream of professional education; there is too much tendency to "think up" films, etc., and then try to merchandise them later. We do not, in saying this, point a derisive finger at the industry. The schools have done far too little to help achieve a unified approach. Nevertheless, the lack of media programs that are genuinely rooted in the schools' concerns remains very serious.
>
> Fred T. Wilhelms
> Executive Secretary
> The Association for
> Supervision and Curriculum
> Development

3. Inadequate equipment

Equipment frequently is not good enough to meet the needs of the classrooms. It breaks down, and there is often no provision for immediate repairs. Not until technical equipment in education becomes as foolproof, teacherproof, and childproof as common household appliances will teachers use it everywhere. But today such equipment is characterized by:

- Poor design -- For years educators have complained about the fact that equipment is poorly designed for their particular needs. So-called daylight screens, for example, in fact require darkened rooms; 16mm film projectors are difficult to operate, heavy to carry around, and expensive; reels of film do become unwound in the classroom.

> The hardware is really in a never-never land of great promise and disappointing achievement. The content is usually nonexistent, where used it is irrelevant, and its integration with the rest of the curriculum is haphazard.
>
> Howard J. Hausman, Head
> Student and Curriculum
> Improvement Section
> National Science Foundation

In part the problem is that educators frequently acquire equipment that is designed primarily for noneducation markets. The equipment does not fit education precisely. For example, one company's decision to limit its new 8mm film cartridge to a four-minute running time was based on home use of 8mm cameras which generally accommodate four minutes of film in each load.

- Incompatibility -- A videotape recorded on the equipment made by one manufacturer cannot be shown on the equipment made by another. A computer program is usually designed for use on only one computer system.

> Our first acquaintance with the videotape recorder brought sharply to our attention the problems related to the fact that there is no compatibility between the products manufactured by one firm and another. Thus software produced with one brand of videotape recorder cannot be utilized on another. This certainly poses a major handicap for those who wish to produce educational software.
>
> John K. Hemphill, Director
> Far West Laboratory for
> Educational Research and
> Development

- Obsolescence -- Once purchased, equipment usually has to be kept until it wears out completely. Thus schools and colleges cannot quickly adopt new easy-to-use equipment in place of outmoded hard-to-use equipment which they have on hand.

> Considering the current inaccessibility of motion pictures in education, 16mm films might better be likened to manuscripts, chained to monastery reading tables, in which case 8mm might be the book liberated and made ubiquitous by the invention of print with movable type.
>
> Louis Forsdale, Professor of
> English, Teachers College
> Columbia University

4. Inaccessibility

Neither the existence of good films, television lessons, or programed courses nor the desire to use them guarantees extensive use. A major problem is accessibility. Expensive film prints are housed in central libraries to be distributed to teachers who have to requisition them months in advance. In many schools (and especially big school systems) the red tape is almost insurmountable. The process is annoying and time-consuming, and alienates many teachers.

Other problems of accessibility include:

- School television producers find it difficult to obtain film footage, stills, or research data on optimal ways of designing programs for the improvement of learning.

- Copyright has made access to much material extremely complex.

> During a recent visit to an inner-city school in a large city, it was brought to my attention by the principal and teachers that in order for them to use the equipment available, it would be necessary for the teachers to leave their classrooms unattended while obtaining the use of the equipment. In a situation where free time is not even provided for the teacher to eat lunch, it seems ridiculous to expect them to take the time necessary to actually physically secure the equipment, not to speak of the time necessary to plan for its use in order to be effective.
>
> Freeman H. Vaughn, Director
> of School Projects
> Industrial Relations Center
> University of Chicago

Instructional technology lacks a well-funded and comprehensive system for disseminating materials, research data on effectiveness, and information about institutions which are making significant uses of technology.

5. Teachers not trained in instructional technology

Where there are good programs, and access to them is well-organized, the use of materials is often minimal because teachers are inadequately trained to exploit what is available. Most colleges of education do not integrate the basics of instructional technology in their training programs. Most courses at such colleges are taught without recourse to instructional technology. In-service training programs in schools which do use technology exert less influence than they should.

> Regardless of whether a school buys a closed-circuit television system, language lab, science lab, or shop equipment, any pretraining in the operation of the equipment is minimal. The equipment, therefore, in many cases lies idle, waiting for an instructor to learn how to use it and to develop confidence in its usefulness in teaching.
>
> Bruce Boal, President
> Hickock Teaching Systems, Inc.

6. Media specialists excluded from central planning

If media specialists are consulted about curriculum and organization at all, it is usually after key decisions have been made. As a result, schools and colleges usually make little effort to weave new kinds of materials and modes of instruction into the fabric of the institution; generally the best programs utilizing the newer media are tacked on as afterthought or optional "enrichment."

Though many instructional technologists blame this critical flaw on the conservatism of the educational system, there is reason to place some of the responsibility on the innovators themselves. In a recent address to a conference of instructional television specialists, Robert L. Hilliard, chief of the educational broadcasting branch of the Federal Communications Commission, said: "We have been content to bow gracefully away from a direct impact upon the curriculum and to permit a curriculum coordinator to determine exactly what will be televised so that it can 'enrich and supplement' -- not change -- the present outmoded content and process in learning and teaching."

> What has become normal, unfortunately, for most school communications people is a world full of mad dashes from one crisis to the next. There is seldom time for effective planning and for doing creative work which is the lifeblood of progress. The technological phase of schooling is now mature enough so that it should have its staffing needs met in a businesslike manner. Limited staff is now the most critical item holding up progress in this area.
>
> A. Richard Clark, Director
> Educational Communications
> Department
> Scarsdale (N.Y.) Public
> Schools

Appendix C

THE COST AND COSTING OF INSTRUCTIONAL TECHNOLOGY

Introduction

Ten or fifteen years from now schools, colleges, and universities will probably be able to determine how much it costs to teach a child arithmetic, what it costs per unit of instruction to teach in the summer as compared with the winter or to teach at night or on Saturdays as compared with the regular school day, how much it costs per unit of achievement to teach inner-city children as compared with suburban children, what it costs to use instructional television or computer-assisted instruction as a part of the regular teaching process compared with not using these devices.

Today none of these comparisons are possible because the accounting practices of educational institutions do not produce the required data. Present practices are primarily fiduciary in nature; that is, their primary purpose is to assure the public that each dollar received is properly accounted for and that each dollar spent has been properly authorized.

Fiduciary accounting systems are used extensively by trust departments of banks and by most government agencies -- federal, state, and local. They serve an important function in society. However, the figures derived from such records cannot be used directly for the management of an enterprise, whether a government agency or a school system. The data have to be reprocessed, supplemented, and analyzed, sometimes at great cost and effort, to make them informative, useful, and even understandable to anybody but the keepers of the records. Without this processing or analysis, it is frequently impossible to make direct cost comparisons between school systems, or even to compare one system's costs from one year to the next.

Nor is this problem new. Beardsley Ruml, once chairman of R. H. Macy's in New York and a long-time leader in analyzing educational economics (from the early 1920s to his death in 1960), called it to the attention of the U. S. Office of Education more than a decade ago.

Cost of Instructional Technology

Well aware, then, of the inadequacy and limited comparability of most available economic data in education, the staff of the Commission on Instructional Technology examined a group of reports by experts on the cost and costing of instructional technology. The conclusions were as follows:

1. Only a small percentage of the annual budget of any school, college, or university is available for instructional materials (including books).

A paucity of funds is a major obstacle to the introduction of instructional technology. No more than 4 percent of per pupil expenditures in public schools in any year is spent for instructional materials of all types -- including textbooks, library books, maps, charts, globes, and laboratory items, as well as the newer media.

Per Pupil Expenditures for Instructional Materials
in Public Schools
1967-68 and 1968-69

Item	National Median		High Quarter		Top Tenth	
	1967-68	1968-69	1967-68	1968-69	1967-68	1968-69
Dollar Expenditures						
Teaching materials	$14.75	$15.08	$18.94	$20.62	$24.98	$27.35
Textbooks	5.10	5.58	7.04	7.67	9.19	9.66
Percentage of total per pupil expenditures						
Teaching materials	3.2%	2.9%	3.8%	3.7%	4.9%	4.7%
Textbooks	1.1%	1.1%	1.4%	1.3%	1.9%	1.7%

Source: School Management, January 1968 and January 1969

On the other hand most school systems, colleges, and universities spend more than 60 percent of their operating budget on instructional salaries. When the heavy costs of building construction and maintenance are added, the average school or college has little left over to meet change through technological or other experiments.

Commenting on this dilemma, Charles J. Hitch, president of the University of California, told an international conference in Paris (April 1969):

> Changes in academic organization, when a university does want to strike out in a new direction, almost inevitably require that most potent of all social lubricants: lots of money.

This, he went on to say, was not usually available.

2. The costs of instructional technology vary widely, depending upon the range of equipment and services.

For example:

- About $700 can buy a 16mm film projector.
- Fifty to sixty thousand dollars can cover the initial cost of a dial-access information system in a college or university, but costs can run into the hundreds of thousands.
- On the average, a closed-circuit television system costs $178,000 to install, and can be operated for $86,000 per year.
- Nine self-instructional units of a physiology course developed and produced at Michigan State University, making use of carrels, audio tapes, slides, 8mm films and programed texts, cost $40,000.
- The high school physics course produced by the Physical Sciences Study Committee (PSSC) cost $6.5 million.
- The Midwest Program on Airborne Television Instruction cost $18 million for the period 1961-1965.

- A simple televised lecture can be produced for as little as $50 an hour, while a presentation making use of film and other visual materials might cost as must as $6,000 an hour.*
- Computer-assisted instruction of the drill-and-practice variety is likely to cost $27.2 million a year in a school district of 100,000 students. But using the computer more creatively as a sort of tutor puts the price up to $71.8 million.*

These are costs for individual applications. On a nationwide basis, the figures are very large. Booz, Allen and Hamilton (Chicago-based management consultants) concluded that:

> If instructional television were installed in the 16,000 public school systems which represent 75 to 80 percent of our elementary and secondary school population, the cost for ITV would be $265 million to $1.5 billion.*

In the spring of 1969, the American Library Association and the National Education Association published a book of guidelines* setting forth standards of equipment and materials required for media programs of good quality and establishing criteria for the media services, resources, and facilities essential in the educational process. Loran C. Twyford, Jr., Chief of the Bureau of Classroom Communications of the New York State Education Department, reviewed the standards and then estimated that if they were fully implemented in one year, the cost would be $38 billion classified in broad categories as follows:

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* Source: Carter, Clyde N., and Walker, Maurice J. Costs of Installing and Operating Instructional Television and Computer Assisted Instruction in the Public Schools. Booz, Allen & Hamilton, Inc., 1968. Prepared for the Committee for Economic Development in 1968 during a study which led to the publication of the report Innovation in Education: New Directions for the American School, Committee for Economic Development, New York, 1968.

Public elementary and secondary schools	(In billions of dollars)
Equipment	$ 8.0
Materials	16.0
Professional staff	1.0
Supporting staff	1.0
Film rental and television	1.0
Subtotal, public schools	$27.0
Nonpublic schools	4.0
Higher education	7.0
Total	$38.0

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* Standards for School Media Programs, American Library Association and National Education Association, Washington, D.C., 1969. The standards presented were prepared by a joint committee of the American Association of School Librarians of the American Library Association and the Department of Audiovisual Instruction of the National Education Association, in cooperation with an advisory board consisting of representatives from 28 professional and civic associations. The publication notes that although the American Association of School Librarians revised its standards in 1960 and the Division of Audiovisual Instruction released standards in 1966, significant social changes, educational developments, and technological innovations made it imperative to bring standards in line with the needs and requirements of today's educational goals.

Twyford calculated that once this investment had been made, it would cost $11 billion per year to operate and maintain a system of instructional technology in the nation's schools, colleges, and universities, including the replacement each year of the equipment and materials becoming worn out or obsolete. S. Barry Morris, Assistant Superintendent for Finance, Fairfax County schools, Virginia, estimated that for a school with 1,000 pupils the annual cost of maintaining and replacing equipment and materials alone would amount to about $42,000 a year or an average of $42 per pupil.

3. The costs of instructional technology could be reduced in a number of ways. For example:

   (a) By increasing the number of students who receive instruction through a particular technology or by increasing the period of time over which the equipment is used. The cost of operating an instructional television system for 10,000 students may be as much as $250 a year per student; however, if the number of students using television were to rise to 500,000, the cost per student could be as low as $12 a year.*

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* Based on data from Costs of Installing and Operating Instructional Television and Computer Assisted Instruction in the Public Schools, prepared for the Committee for Economic Development, 1968.

If the television system could be operated for more than the usual number of hours in a typical school day, and for more than the usual number of days in a typical school year, then the cost per student could be cut again.

Richard E. Speagle, professor of finance at Drexel Institute of Technology, observed after analyzing data on the costs of instructional technology submitted to the Commission:

> The annual bill at schools, colleges, and universities for physical facilities, like science and language laboratories, gets folded into total costs without reference to degree and intensity of use.
>
> In industry, by contrast, inputs of plant and equipment are firmly controlled by a benchmark of performance, "standard costs." These shoot up sharply when the utilization rate falls below a desired percentage of capacity.

In order, then, to benefit from the economy of large-scale operation, schools, colleges, and universities would have to pool resources. To date, however, cooperative arrangements between educational institutions of the requisite magnitude have not been made. A prime reason appears to be opposition by those teachers who resist any threat to their traditional autonomy.

(b) By stepping up the output of products that educators want.

(c) By designing and building instructional machinery specifically for instructional purposes.

Lawrence Parkus of Radio Corporation of America told the Commission that the IBM 1500 system, for example, which is being used for computer-assisted instruction, was originally designed for such tasks as process control of cracking towers in petroleum refineries. Consequently the system incorporates many expensive features not needed in elementary and secondary schools. Some people believe that a computer designed especially to meet school needs might be cheaper than existing or projected commercial models -- although the Commission has heard from well-informed sources who believe otherwise.

The halting growth of computer-assisted instruction in elementary and secondary education has been, above all, a function of the high, indeed exorbitant costs of the medium. These costs include hardware, software, and general operating expenses. Until these costs are significantly reduced, it is impossible to predict when, if ever, computer-assisted instruction will be absorbed into the mainstream of the instructional process at the elementary and secondary levels.

* * *

There is a rather widely held belief within the educational community -- by those who are involved in computer-assisted research and development as well as those who are users or potential users of the medium -- that the advancing state of the art of computer technology will significantly reduce the costs of computers and peripheral equipment. This belief reflects a serious misunderstanding of the computer industry and its major marketing thrust.

* * *

Data processing equipment has, is, and will continue to be designed to serve the needs of extensive and well-endowed commercial and scientific markets. The users in these markets require data processing equipment that possesses extremely sophisticated and complex capabilities. Computer-assisted instruction systems now used in education are created from this equipment which, in many cases, offers capabilities not needed, in other cases lacks capabilities required in education.

* * *

If the potential of computer-assisted instruction is to be realized within a reasonable time, a system must be developed for education which possesses the data processing capabilities peculiarly required by educators and falls in a much lower price range than is possible at present. Federal and state educational funding authorities must supply the initiative for this program of research and development.

Lawrence Parkus
Radio Corporation of America

(d) By increasing the speed at which a student learns.

If the average student aided by instructional technology could master a given curriculum in less time than with traditional methods, the cost of his education could drop. In some branches of the Air Force, for example, the introduction of programed instruction has reduced training time by about 30 percent, with the financial savings more than offsetting the development costs of programed instruction.

In order to achieve these savings, however, educational institutions may have to reorganize themselves. In some cases, for instance, a student able to obtain the objectives of a programed course more rapidly than the rest of his group cools his heels until the rest of the class catches up.

4. Most data on the costs of instructional technology lack the necessary scope and depth to help education's managers make policy decisions.

The data are usually subject to many limitations and footnotes, sometimes to a heavy burden of reservations. In some cases the data yield only future models. For these, the range of cost estimates varies widely, depending upon the assumptions.

For example, a model prepared by Booz, Allen and Hamilton assumed:*

> A system having (a) a student population of 100,000 in grades one to 12; (b) 152 schools of 24 classrooms each; (c) 30 pupils per elementary class and 25 per secondary class; (d) continuous operation through a six-hour school day for 150 instructional days per school year; and (e) one hour of instruction per student per day through television and one hour through computer-assisted instruction.

For this single specific model, cost projections ranged from $800,000 to $4,600,000 a year. Obviously a range of this magnitude -- where the top figure is more than five times as large as the bottom figure -- rules out the making of a firm policy decision.

5. The costs of instructional technology cannot be considered in isolation. They must be compared with the costs of other forms of instruction, as well as the real costs to society of an unproductive education system.

The comparative figures needed depend on (or can only be generated by) the kind of cost analysis techniques pioneered recently by business and government, including systems analysis, cost-benefit and cost-effectiveness analysis, and planning-programing-budgeting system (PPBS). A few educational institutions, such as the University of California under President Hitch (a key figure in introducing PPBS into the Department of Defense), Stanford University, Princeton University, and the University of Toronto are experimenting with these techniques, financed partly by grants from the Ford Foundation. And a cost-benefit analysis has been worked out to identify the relative effectiveness of various Job Corps centers.

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* Prepared for the Committee for Economic Development in 1968 during a study which led to the publication of the report Innovation in Education: New Directions for the American School, Committee for Economic Development, New York, 1968.

Notes on techniques of cost analysis:

Systems analysis, a technique for problem solving already used by industry and government (someday it may be used extensively in education) raises three main questions about an organization's activities:

1. What are the objectives to be reached?
2. How can these objectives be reached most efficiently?
3. How do we know when the objectives have been reached?

In developing answers to these questions, the researcher has to consider the organization involved both as a whole and in parts; also the relationship of the various parts. When applied to education, the technique considers the many different components which interact with each other (in a school, for example, such components as students, teachers, parents, buildings, books, technology, lunch programs). Although precise descriptions of the interrelationships are vital to the process, they are, obviously, difficult to obtain.

Cost-benefit and cost-effectiveness analysis are used in the second stage of systems analysis in order to choose among alternatives for reaching the desired objectives. The best alternative is the one which has the highest ratio of benefits to cost. Cost benefit, the broader category, includes cost effectiveness, which may be measured concretely in dollars or valid test scores. In addition, cost benefit includes such aspects as enjoyment or recreation, which may be deeply felt but defy precise quantification.

Planning-Programing-Budgeting System (PPBS) is, in effect, cost-benefit analysis conducted on a big scale. It is a fiscal form of systems analysis designed to assist decision-making.

James G. Miller, vice president of EDUCOM, states the problem which PPBS sets out to answer as follows: "With a given level of resources available, the task of an educational administrator is to select the policies, people, facilities, and equipment that will give the students the 'best and biggest education per buck.'"

Richard E. Speagle
Drexel Institute of
Technology

Until now the results of cost-analysis techniques at educational institutions have been fairly crude. The reasons are not hard to find. To be successful these techniques require far more knowledge about the process of education than is available today. For example, what are the specific objectives of education? of teaching particular subjects or particular skills? What input or volume of resources applied to a learning situation causes which output? which benefits? What is the relationship to teaching and learning of nonschool factors (as, for instance, how much does diet affect learning ability)?

In writing about these matters, Richard Hooper, Harkness Fellow studying educational technology in the United States, told the Commission that the acquisition of objective data about the costs and benefits of various forms of instructional technology would require a "great will to do the job," this to accompany a vastly increased research program. Even granting that such effort could be mounted, moreover, Hooper noted that education, essentially a human process, would always defy measurement. He added:

> If analytical techniques (similar to those used in industry which deals in definable products and profit objectives) are applied uncreatively, they might drive out the moments of spontaneity, the intuitive idea, and the unpredictability of human relationships.
>
> The benefits of education which can be given a dollar value (for example, students' earning power in later life) should not be overemphasized at the expense of benefits which resist economic analysis.

Appendix D

INSTRUCTIONAL TECHNOLOGY AND THE POOR

Can technology help to meet what many regard as the most pressing problem in education today: the needs of the poor -- in the central cities, in depressed rural areas, on Indian reservations.

Not surprisingly, there is very little evidence at present on which to base a sound conclusion. Most of the experimentation with instructional technology has been in the more affluent school systems. It is hard to find money for teaching machines and television sets in a school which lacks paper and pencils, decent lighting, adequate plumbing, or even minimum maintenance and safety provisions.

But based on what little evidence does exist, and on the judgments offered to the Commission by educators, specialists, and students themselves, it does seem that technology, wisely and comprehensively used, could help greatly to upgrade the education of the poor. If so, the investment required should surely assume high priority on the nation's list of unfinished business.

This section highlights the magnitude of the problem and a few of its salient features, and then presents positive and negative views on instructional technology's potential role in reaching some solutions.

The Magnitude of the Problem

Some of the inequities in the nation's educational system stem directly from geography, some from the way schools are financed. Other are the bitter heritage of poor and minority groups -- blacks, Puerto Ricans, Mexican-Americans, Indians, the rural poor, and migrants to the city.

One major obstacle to fulfilling America's commitment to universal public education and equality of educational opportunity is the haphazard pattern of support for education across the nation. Some school districts spend more than $1,500 per year per pupil while others spend less than $400. These figures are not necessarily an indication of a community's effort to support their schools. The district paying $400, for instance, might be taxing itself two or three times more per dollar earned than the richer district paying $1,500. Moreover, since the bulk of revenue going to schools is drawn from local property taxes (about 52 percent nationally) those communities with the most valuable (that is, taxable) properties fare much better than the poorer communities.

> This grant of unequal power to tax is the central fact of life in school finance, and if taken by itself implies a public policy that the rich deserve better educational services than the poor.
>
> National Committee for
> for Support of the
> Public Schools

Inequities in educational opportunity penalize millions of American children. In attempting to better the lot of children thus penalized, educators, technologists, and social reformers should consider a number of special factors.

- The Rural Poor -- There are 14 million rural poor in America. (There would be more if so many hadn't moved to the cities.) Low salaries, coupled with the drawbacks many teachers find in small-town life, make it difficult for rural schools to attract and hold qualified teachers. The percentage of uncertified teachers in rural areas is twice as high as it is in metropolitan areas.

In recent years there has been a considerable amount of consolidation of small school districts -- enabling schools to have better facilities and staff -- but many rural schools are still ill-equipped, some with outdoor privies, some without running water. And today there are still about 10,000 one-room schools in this country. Schools lacking basic necessities (and even many which have them) naturally lag far behind in more sophisticated equipment -- language and science laboratories, etc.

- American Indians -- In the United States about 600,000 people belong to more than 300 different Indian tribes. Almost half leave school before completing high school, and 75 percent live on incomes under $3,000.

At one elementary school for Indian children a highly elaborate teaching system was set up under the direction of a private company. Daily tests were administered on the concepts that had been taught in each subject area. Test results were processed by a computer and a printout of the conceptual areas in which each child was deficient was given to teachers before the beginning of school the next day.

At the same time, several hundred films had been catalogued according to the concepts they presented. The computer searched out the films which corresponded to the areas in which most of the students appeared deficient. The relevant films were transmitted by closed-circuit TV throughout the school. Teachers could make the choice as to whether they wished their class to view a film, which film, and when.

The elaborate program was discontinued the next year much to the relief of students and teachers. The term "concept" had not been sufficiently defined; many of the films which were to teach specific "concepts" actually were irrelevant to the teachers' purposes; or the film took much too long to achieve what the teacher could do alone in a matter of minutes. Observers reported that toward the end of the school year most teachers left their TV receivers turned off all day long.

Vincent P. Kelly
Bureau of Indian Affairs

Most Indian children enter school handicapped by impoverished backgrounds and also by a serious language problem. At a school on one large reservation, for example, 95 percent of the six-year-olds regularly begin school speaking no English at all.

The educational needs of American Indians are not too different from those of other minority groups: more and better teachers;

teachers who understand and respect them; a curriculum which is relevant to Indian life, history, and culture. But perhaps most pressing is the Indians' need for active participation in their children's education, and control over their own schools.

- Mexican-Americans -- One-sixth of the school-age population in the five southwestern states is Spanish-speaking. In 1960, in California alone, about half the population of Spanish-speaking 14-year-olds and over had not gone beyond the eighth grade. Here again the language problem is fundamental.

> Ironically the child who enters school with a language deficiency and the cultural deprivation of long-continued poverty is often made unbearably aware of his disadvantages. School is supposed to help him solve these problems; instead it convinces him that they are beyond solution.
>
> Herschel T. Manuel
> Spanish Speaking Children of the Southwest, Their Education and the Public Welfare

In 1965 the National Education Association asked a group of Tucson, Arizona, teachers to study the education of Spanish-speaking people in the Southwest. The results of the survey, published in a book called The Invisible Minority, were summed up thus: "Is there something inherent in our system of public schooling that impedes the education of the Mexican-American child -- that indeed, drives him to drop out? And the answer, unhappily, must be yes."

- Urban Ghettos -- The most concentrated, dangerous problem in American education today lies in the ghettos of our big cities. The schools there have been overwhelmed by difficulties, and lack the capacity to master them.

Urban schools have not succeeded in providing the vast majority of black, Mexican-American, and Puerto Rican children with education that might help overcome the effects of discrimination and poverty. The Coleman report* revealed that black students fall further behind whites for each year of school completed. In the metropolitan Northeast, for example, black students on the average begin the first grade with somewhat lower scores on standard achievement tests than white students, lag about 1.6 grades behind by the sixth grade, and have fallen 3.3 grades behind by the twelfth grade. One result is that many more black than white students drop out of school. In the metropolitan North and West, black students are more than three times as likely as white students to drop out of school by age 16-17.

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* James S. Coleman, et al., Equality of Educational Opportunity, U. S. Office of Education, 1966.

An official report on the educational system in Newark, New Jersey, puts the picture in statistical terms:

- One-half of secondary pupils are or will be functionally illiterate when they complete their high school education.
- In grade seven, Newark's average on the Stanford arithmetic test was 5.1 compared to the national norm of 7.2.
- The dropout rate from 1962-1966 (cumulative) was 32 percent.
- The public school system is $250 million behind in capital construction, yet the city and school board have reached legal bonding limits.
- 30 of the 75 buildings were constructed before 1900; 44 are more than 50 years old.
- 35 of the 50 elementary schools are operating at from 101 to 151 percent of capacity.
- 28 percent of the children leave Newark's system each year for suburban or parochial schools; they are replaced by southern Negro immigrants and Puerto Ricans from New York City.

Report for Action
Governor's Select Commission
on Civil Disorder
State of New Jersey,
February, 1968

To make matters worse, the economic cards are stacked against those blacks who do persist through school and college. According to a recent Census Bureau report, black college graduates earn only 74 percent as much as white college graduates, and their median income is only $13 more per year than that of whites who never went beyond high school.

Present Obstacles

These problems will not yield to any panacea. When America finally began to recognize the state of ghetto education a few years ago, the prevailing view was that once certain handicaps were surmounted, the disadvantaged child could then benefit from the standard school fare designed for middle-class white youngsters. Based on this approach, preschool programs have provided needed health and psychological services, as well as some of the social experiences common to most middle-class homes or nursery schools. But the spurts of measurable growth thus achieved and the momentum begun in such programs are imperiled once children move into public school. Studies now suggest that "compensatory" education must begin in infancy or shortly thereafter.

As for secondary schooling, many educators have now concluded that mere "enrichment" -- exposure to experiences commonplace among middle-class youngsters -- is unavailing in the struggle to hold the interest of the ghetto adolescent. As with the youngest children, a quite distinctive program appears essential, including powerful components of ethnic culture and projects that really mean something to the students.

> Only in the American public-school system is the Indian still roaming the plains in search of bison, the black still on the plantation, and Africa still a dark continent.
>
> Ben A. Watford, Student
> Graduate School of Education
> Long Island University, N.Y.

Bernard E. Donovan, former superintendent of New York City Schools, recently defended the schools as "still doing exceptionally well those things they have always done well" -- that is, educating the majority of middle-class white children. But, he said, "deficiencies lie in the system's difficulty of coping with a new and massive group of seriously disadvantaged children. . . .Unfortunately we, in addition to every other large city in the nation, have not been able to marshal effectively our own and all the other forces of society which must be brought together to solve this problem."

The failure of schools to cultivate the most basic skills of reading and writing is particularly critical. David X. Spencer, a black community leader and the elected chairman of the Governing Board in East Harlem's I.S. 201 Complex, put it plainly to a white reporter: "I don't care what your hangups or my hangups are. We can get along as long as my kid is learning to read and write."

The sheer complexity of the problem of ghetto education precludes a technological or any other "fix." A noted black psychologist, Dr. James P. Comer of the Yale Child Study Center, told the Commission:

> Instructional technology introduced into a school or system operating at a "survival level" can be another burden for administrative and teaching personnel. Increasing the vocabulary of a child through instructional equipment will usually be of limited value in a chaotic system not capable of producing or sustaining a learning environment. All too often, help for the inner-city school has been an input of new ideas, people, programs, etc., without systematic attention to the critical aspects of basic school programs.
>
> Unlike the good football teams which, when showing signs of slipping, revert to fundamental patterns of blocking, tackling, and passing, schools have gone for the razzle-dazzle plays. Cultural enrichment, ethnic relevance, new technology, fancy new buildings, and the like have been the response to the crisis in inner-city education. The principal of one inner-city school recently counted twelve new program inputs in his school within three years, all now abandoned, none carefully evaluated, with little apparent impact on the youngsters.

In some respects, resistance to the introduction of technology into ghetto schools resembles the resistance encountered even in wealthy suburban school systems. Some educators and citizens feel that instructional technology would merely serve to distract attention from basic problems; in the case of the ghetto -- control, governance, financing. And some critics believe instructional technology may even have positive disadvantages. In this view, the slum child's prime need is a continuing close relationship with his teacher; he may react adversely to the intervention of impersonal technology.

In reviewing for the Commission the situation in sixteen cities Alva R. Dittrick, of the Research Council of the Great Cities Program for School Improvement, reported a number of promising technological experiments, but summed up overall progress as follows:

> At the present time, a direct assessment of the impact of instructional technology on making learning more relevant for ghetto children cannot be made adequately. Operational situations simply do not exist in which large-scale coordinated use of instructional technology is being applied to classroom situations.
>
> Isolated success stories and promising practices related to the use of specific machines or programed instructional materials can be identified. For the most part, they are singular instances without consistent application as a regular integral part of daily instructional activities. At this point in time, the application of instructional technology must be considered to be in a trial-and-error, exploratory period.

There is, then, need for sustained and well-financed research and development programs which could point the way toward effective and comprehensive use of technology in ghetto schools.

The State of the Art

What has been learned from the limited experience to date in using technology to enhance learning for the children of poverty? Three chief points were stressed by the experts whom the Commission consulted:

1) Instructional technology should put the student in an active, independent learning role, in contrast to conventional classroom procedure which requires him to spend most of his time passively sitting and being talked at. There should be ample opportunity for students to actually touch and use equipment themselves in order to gain a sense of mastery.

2) To be effective, instructional technology must be responsive to the people it is designed to serve. There is a fear, for instance, that since ghetto schools have received the short end of the stick in education generally, they are destined to receive only the most pedestrian, shortsighted, and harmful applications of technology. In the design and use of hardware, therefore, and even more in the concept and production of programs, ghetto residents -- students and adults -- should have an important voice.

3) Instructional technology should be used comprehensively. Merely introducing a film or a record from time to time will not make any significant impact in the ghetto (or any other) school. Only through a coordinated and intensive use of a broad repertoire of new media -- including the most effective use of good teachers -- can a significantly better environment for learning be created.

- In the St. Louis School System emphasis is being placed on speech improvement in inner-city schools through the use of tapes, tape recordings, and radio lessons.

- The Baltimore School System has developed closed-circuit television instruction in math for selected children in junior highs with large concentrations of disadvantaged children. Longitudinal studies are being made to determine effectiveness of this technique over conventional approaches. A similar study is being conducted in senior highs with experimental and control groups.

- The Los Angeles Public School System has developed and is evaluating instructional programs designed to improve oral English of Negro and Mexican-American children, using various media including recorders and auto-tutors.

- In San Diego junior highs, electronic classrooms have been organized to teach foreign languages. Closed-circuit television is being used to transmit 75 systematically prepared tape lessons to facilitate teaching English as a second language.

- The Cleveland Public Schools are studying the effect of programed instructional materials on development of basic reading skills, in an attempt to identify successful approaches with children in six inner-city schools.

- The New York Public Schools' "More Effective Schools Program" has made abundant quantities of equipment and instructional materials available to teachers. The effects of mechanical facilitators such as overhead projectors, film cartridges, film libraries, and teaching machines are being studied.

- The Philadelphia schools have developed a Language Arts Communication Media Program. Students are provided with opportunities to employ communication media such as motion pictures, still photography, and tape recorders to extend their understanding and appreciation of literature and competence in spoken and written expression. Teachers are trained in techniques necessary to implement the program. Teachers and students work with various types of equipment. Much individualized instruction is required.

- The Boston School System has developed an Interdisciplinary Slide/Film Program. This material was created by ninth-grade students. The Concept of The Hero was developed in an interdisciplinary context making use of a slide/tape presentation.

Alva R. Dittrick
Research Council, Great Cities
Program on School Improvement

Today, if only in a small way, instructional technology is helping teachers to establish new educational contact with poor children. Where with traditional techniques children have failed to reach a satisfactory level of achievement, new approaches -- such as talking typewriters and other programs and equipment specifically designed to improve reading instruction -- are offering fresh alternatives and options. Materials and machines are creating environments that challenge children to respond as they have not in the past.

An important element in altering the educational environment which various forces of instructional technology can provide is a reward system that evokes the child's intrinsic drive for competence. Programed instruction, for instance, can enable the child to grasp a relationship or an idea and thereby generate enthusiasm for further learning.

Hopes for the Future

Limited as it is, experience to date suggests that technology could help solve major instructional problems of schools in districts serving poor and minority-group students. Cameras and recorders, for example, help to dilute the oververbalism of schools and relate education dramatically to the students' out-of-school life. These and other media foster original experession and help to make learning more individual and effective. On the basis of results thus far, many hold high hopes for technology's potential effectiveness in ghetto and other disadvantaged schools. Technology would at least replace incompetent or unsympathetic classroom teachers for some of the time. Too often teachers in ghetto schools disapprove of students' styles of behavior or speech, and sometimes, knowingly or not, of their color. A teacher's belief that children are not capable of learning can become a self-fulfilling prophecy.

Technology, properly used, could sidestep many of these problems. A teaching machine or talking typewriter is infinitely patient and adaptable to a child's pace or needs, and is not offended by his dress or speech. A film or language tape can provide information and drill unaccompanied by censure and irritation. In particular, instructional technology could prove invaluable in facilitating what many feel to be the most acute problem of all -- learning to read. Programed instruction and the computer with its capacity for endless repetition are likely reading tutors for the ghetto child, as experiments are beginning to demonstrate.

Technology can serve as a powerful creative tool for all kinds of students, but most of all perhaps for the underprivileged. In Philadelphia, a group of young gang members and former delinquents formed a movie production company which provided not only emotional and artistic satisfaction but which also vastly expanded their perception, understanding, and pocketbooks. In many large cities ghetto youth, provided with cameras by various film companies, have felt whole new horizons open out before them.

Putting all these pieces together, some observers see in instructional technology the promise of developing a comprehensive, potent teaching strategy which could be uniquely effective with deprived and minority-group youngsters. It could actively engage them in the learning process through all their senses and modes of awareness; it could adjust to the individual learning style of each child; it could bring material of relevance and interest into the school; it could filter out the antagonism and indifference of some teachers; it could open the school to the media-rich environment. Such a comprehensive system of instruction is admittedly visionary, but experience to date is hardly an adequate guide to future possibilities.

Appendix E

TECHNOLOGY AND THE EDUCATION OF THE HANDICAPPED

Toward the end of its study, the Commission on Instructional Technology noted that the Congress was considering legislation for the establishment of a National Center on Educational Media and Materials for the Handicapped.

This center is expected to provide a comprehensive program for developing instructional media and materials for use in educational programs for the handicapped; adapting instructional media and materials now in use for the handicapped; and familiarizing and training teachers of the handicapped to use the new educational media and materials available.

When the congressional committees responsible for the legislation reported out the bills providing for the establishment of the center (in mid-1969), they observed that although the federal government has been committed for nearly a decade to programs for training teachers for handicapped children, there are still far too few teachers available. The testimony presented to the committees showed that:

- The Department of Health, Education, and Welfare estimates that more than 300,000 teachers, speech pathologists, audiologists, and other specialists are needed at the present time to work with handicapped children. Only 75,000 to 80,000 teachers and specialists are now available for those children.

- Only 2 million of the 5½ million handicapped children needing special education services are receiving them.

- Even if funds were available it would not be possible in the near future to educate and train a sufficient number of teachers and specialists for handicapped children. The problem is that a sufficient number of trained persons who can train teachers of the handicapped does not exist.

- Many applications of communications technology can be made to the special problems of the handicapped. For example, educational television, commercial radio and television, and computer-assisted instruction may help solve teacher shortages and provide educational programs to those handicapped children not able to attend a special school. The potential of these developments has yet to be carefully analyzed.

- The Office of Education has been supporting 14 regional Instructional Materials Centers. These centers have been so successful in demonstrating the usefulness of instructional materials in the teaching of handicapped children that states and local communities, using local sources of funding, have established more than 80 associate centers to distribute these materials.

- There is a need for a national center which will coordinate the various aspects of a comprehensive media and materials research, development, and delivery system for making instructional media available to all handicapped children.

> Interdisciplinary, collaborative research is a must in the study and investigation of the needs of the mentally, physically, and emotionally handicapped in any state program. In order to give depth and breadth of understanding to the concepts which underlie the principles of special education and rehabilitation, it is necessary for workers in the fields of psychology, sociology, and medicine to combine their knowledges in conducting research for physically and mentally ill children and adults.
>
> Research findings, in order to be of some value, must be made readily available to practitioners. These include workers on all levels as well as professional educators, supervisors and administrators, employers, families, and the general public.
>
> Peter J. Salmon, Chairman
> Ad Hoc Committee on Education
> and Training of the Handicapped

The Commission on Instructional Technology noted as its report was about to be completed that both the findings and the recommendations by the congressional committees were consistent with those the Commission has incorporated into other sections of this report.

Appendix F

THE ESTABLISHMENT OF THE
COMMISSION ON INSTRUCTIONAL TECHNOLOGY
AND THE CONDUCT OF ITS STUDY

Establishment of the Commission

On November 7, 1967, before 500 educators and broadcasters and a battery of television cameras, the Public Broadcasting Act became law. Created thereby was the Corporation for Public Broadcasting, a quasi-governmental body designed to rally and focus support for noncommercial television and radio.

In signing the act into law, the President said:

> Noncommercial television can brings its audiences the excitement of excellence in every field.
>
> A vital and self-sufficient noncommercial television system will not only instruct, but inspire and uplift our people.

The need for the Corporation had been described some months earlier by the Carnegie Commission on Educational Television, a committee of educators and civic leaders established and privately financed as a public service by the Carnegie Corporation of New York. Although the Carnegie Commission had excluded from its study the formal instructional aspects of television and radio, it had emphasized their potential importance, and recommended a study of the instructional uses of these and other technological media. The Public Broadcasting Act provided for this study, but the title involved did not receive an appropriation from Congress.

In March, 1968, the Secretary of Health, Education and Welfare appointed a nine-member Commission on Instructional Technology and asked the Office of Education to allocate the needed funds for its activities. On April 22, 1968, the Commission met with the U. S. Commissioner of Education to discuss the scope of its assignment.

The Commissioner provided a broad mandate for the study by saying:

> The scope of the Commission's work should be wide-ranging. Every aspect of instructional technology and every problem which may arise in its development should be included.

He then went on to say:

> The independence of this Commission must be maintained. The Commission is not an adjunct of the U. S. Office of Education. Therefore, except for this initial meeting, neither the Commissioner of Education nor any member of his staff will take part in the Commission's activities, unless asked specifically for information.

In July 1968, the Commissioner further described the rationale for the assignment to the Commission when he said at a national convention:

> We have reached the point where we have simply got to come up with a more orderly, informed way of taking advantage of all that the new technology has to offer.
>
> The new educational technology holds no more exciting prospect for American education than the possibility of providing -- on a scale and to a standard far beyond our grasp -- an educational system able to respond to the unique needs and abilities of the individual learner.
>
> One problem is: how do we do this economically, at a price both industry and educators can afford?
>
> Even more important: how do we design and develop this technology so that it meets the needs of both the individual student and the educational system as a whole?
>
> These are questions that none of us -- in education, in industry, in government -- can answer except by asking them of each other, over and over and over again.

How the Study Proceeded

At the April meeting the Commission on Instructional Technology selected the Academy for Educational Development, a nonprofit educational research and consulting firm, to undertake the necessary staff work. The Commission and the staff then proceeded, in the light of the broad mandate for the study, to:

- Examine the whole gamut of instructional technology -- old, new, and future; printed, mechanical, and electronic; automated and cybernated; from books to computers, from carrels to learning centers, from overhead projectors to satellite transmission; from preschool to graduate school.

- Study instructional technology as a whole, as a system greater than the sum of the various media.

- Consider the many critical questions raised by the application of technology to education.

- Weigh technology's potential toward alleviating the urgent problems now confronting America's schools and colleges.

- Examine the federal role, past and potential, in educational technology.

The Commission invited observations and opinions from a broad sample of the educational community, business and industry serving education, and other institutions, individuals, government agencies, and associations interested in education or technology. In addition, invitations to communicate with the Commission were placed in trade and professional publications.

Simultaneously, a series of questions were drawn up that were designed to probe broad policy matters as well as technical details and specific uses of instructional technology, in order to obtain expert information and opinion on every phase of the Commission's mandate. The Commission arranged for the preparation of more than 150 papers from "establishment" representatives as well as mavericks, from scholars, politicians, social critics, and generalists as well as from specialists and practitioners.

Commission meetings were convened at various places throughout the country in order to permit visits to be made to a variety of projects (in public schools, universities, the armed services, industry, the Job Corps, etc.). The meetings often included discussions with theorists and practitioners in instructional technology.

The Commission also participated in a number of seminars arranged to elicit a range of views and experience in different aspects of instructional technology. For example:

- A seminar to explore communications satellites and their implications for instructional technology, which included representatives of the National Aeronautics and Space Administration, the National Association of Educational Broadcasters, the Federal Communications Commission, National Educational Television, the U. S. Office of Education, the President's Task Force on Communications Policy, and the Joint Council on Educational Telecommunications.

- A seminar to explore developments in instructional television, which included network, ETV station, and school people, as well as representatives from such associations as the National Association of Educational Broadcasters, the Joint Council on Educational Telecommunications, and the National Education Association.

- A seminar to probe student reaction to instructional technology (both pro and con); participants were twenty high-school and college students, all of whom had had varied experience with technological media.*

- A seminar with fifteen elementary-school and high-school teachers of varying background and experience in instructional technology.

- A number of seminars with technology specialists, and with representatives of educational and industrial associations concerned with technology.

Meantime, staff members and special consultants conducted interviews and field trips, and prepared reports on a wide variety of projects and organizations involved with instructional technology. Included were military installations, museums, and business organizations, as well as programs and activities conducted by schools, colleges, and universities.

The staff also searched out and catalogued a library of relevant materials, both published and unpublished. Selections from this material as well as the reports prepared especially for the study were reviewed by the Commission.

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* The student seminar was co-sponsored by the Institute for Development of Educational Activities, Inc. (I/D/E/A), an affiliate of the Charles F. Kettering Foundation.

Finally, liaison was established with departments and agencies of the federal government concerned with instructional technology, with Congressional bodies, and with quasi-governmental organizations.*

The Commission was gratified by the interest manifested in its work. Scores of distinguished people -- scholars, technicians, practicing schoolmen, reformers, and others -- prepared papers or granted interviews. Hundreds of thoughtful letters came in response to the Commission's invitation. They came from industry; from superintendents and staff members of big school systems such as Detroit, Chicago, and New York, and from dozens of smaller places; from nearly every state office of education; from the deans of education of leading universities; from college deans, department heads, and professors in many specialities, including computer science, behavioral research, medicine, engineering, instructional resources, communications and television.

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* Including the Federal Communications Commission; the Corporation for Public Broadcasting; officials in the U.S. Office of Education charged with administering such legislation as the Educational Professions Development Act (which provides grants to help solve the critical shortage of education personnel and to improve their training), the National Defense Education Act (which provides grants and loans for the acquisition of certain kinds of equipment), Title I of the Public Broadcasting Act (which provides federal financial assistance for noncommercial educational radio and television broadcast facilities), the Higher Education Act (which provides funds to institutions of higher education for the acquisition of television, laboratory, and other special equipment), and the Higher Education Facilities Act (which provides grants and loans for construction and improvement of facilities); and sponsors of such proposed legislation as the Educational Technology Act of 1969.

Through all these varied means, the Commission was enabled to arrive at a realistic picture of instructional technology as it exists today in the United States, to assess its values, and to form a responsible judgment on its probable future.

Appendix G

PART I: PAPERS PREPARED AT THE REQUEST OF THE COMMISSION ON INSTRUCTIONAL TECHNOLOGY

ALTER, Chester M.

The Potential of Technological Instruction for the Less Affluent College

ANDERSON, Robert H.

Changes Necessary in the Organizational Patterns and Administrative Procedures of Schools and Colleges in Order for New Techniques to Effectively Improve Instruction

BAIR, George E.

The Promise that Technology Holds for Education

BAZEMORE, A. W. and SILVERZWEIG, Stanley

Toward a Learning Technology for the Inner City Schools

BEAMISH, Eric E.

Educational Technology and the Preparation of Teachers

The Instructional Technologist and Some Recommendations for his Professional Preparation

BECKWITH, Hugh

Innovation in Industry that Appears Likely to Affect Instructional Technology During the Next Ten Years

BELL, T. H.

Changes that will be Necessary in the Organizational Patterns and Administrative Procedures of Schools and Colleges in Order for New Technologies to Effectively Improve Education

BELZER, Jack

Patterns for Development of Education in Information Science

BITZER, Donald L. and SKAPERDAS, D.

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BLAISDELL, W. M.

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BOLVIN, John O.

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BORD, Nancy A.

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CRIM, Alonzo A.

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DAVIES, Don

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DE LONE, Richard H.

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DEMPSEY, Rev. Michael J.

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